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MEAT HYGIENE

By

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Illustrated

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PREFACE

MEAT hygiene as dealt with in this text covers the broad field it has attained in the United States. The text is addressed primarily to veterinary students and veterinarians because, as a group, they are prepared by their education and training to perform two basic services in the field of meat hygiene, namely, ante-mortem examination of food animals and post-mortem examination of their carcasses. Yet the subject of meat hygiene is broader than ante-mortem and post-mortem services combined.

Meat hygiene is as broad as the consumer's interest in the meat he eats. He expects his meat to be derived from animals that are healthy at the time of slaughter. He expects these animals to be slaughtered under conditions that assure the elimination of diseased carcasses and meat. He expects that the meat will be kept clean and handled under clean conditions during each stage of its preparation and merchandising up until the time it reaches his table.

He expects, furthermore, that there will be no adulteration of the meat during its handling and preparation, and as a companion interest, he expects truthful labeling. Grading and grade labeling have come into the field of consumer interest in recent years. This subject, therefore, is also included in this text.

It is important that the student and practitioner of meat hygiene realize that meat hygiene does not constitute some luxury which might be handled lightly or overlooked entirely in the many activities of the slaughterhouse or market place. On the contrary, the consumer, as a member of modern society, is entitled as a matter of right to have the meat he eats handled and prepared with full regard for all recognized principles of meat hygiene.

Those who expect to engage in the field of meat hygiene control have the responsibility of learning thoroughly all the principles involved so as to be able to apply them effectively. Such application depends on individual initiative functioning in an adequate control program.

This text covers all levels of responsibility. The principles are the same for a small butcher shop as for the largest packing house and except as volume may be a complicating influence, the detailed handling of operations is similar. The author hopes that, in addition to persons of veterinary training, others responsible for sanitation and supervision of meat processing will find this text useful by observing how their duties supplement the functions of veterinarians in the complete program of control.

Since the intelligent application of the principles of meat hygiene leads to consumer acceptance of the products of a vast livestock industry, it serves a two-fold purpose. It protects the public meat supply and safeguards the Nation's livestock economy.

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CONTENTS

CHAPTER 1

HISTORY

CHAPTER 2

ELEMENTS OF MEAT HYGIENE

CHAPTER 3

ANTE-MORTEM INSPECTION

CHAPTER 4

POST-MORTEM INSPECTION

Chapter 5

TRICHINOSIS

Chapter 6

PHYSICAL AND CHEMICAL CHARACTERISTICS OF MEAT AND THE PRINCIPAL ORGANS

Chapter 7

FACILITIES RELATING TO SANITATION IN PLANT OPERATION

CHAPTER 8

FACILITIES FOR INSPECTION

CHAPTER 9

MATERIALS ADDED TO MEATS

CHAPTER 10

PREPARATION OF MEAT AND MEAT FOOD PRODUCTS

CHAPTER 11

MEAT GRADING

CHAPTER 12

ADULTERATION AND MISREPRESENTATION

CHAPTER 13

DETERIORATIVE CHANGES IN MEAT

Chapter 14

ORGANIZED MEAT HYGIENE CONTROL

APPENDIX

Chapter
1
HISTORY

General.—Since antiquity, as various civilizations developed throughout the world of which we have any historical record, man has attached importance to the source and handling of his meat supply. From time to time this has included requirements, restrictions, and even taboos influenced by philosophies of diet, religious practices and their ritualistic ramifications. As civilization makes itself felt on groups of people, conscious efforts are made to separate themselves as far as possible from practices of savagery. They no longer are satisfied with being scavengers. The old testament, in Exod. 22:31, reads "And ye shall be holy men unto me: neither shall ye eat any flesh that is torn of beasts in the field; ye shall cast it to the dogs."

Hebraic.—The quotation given above from Exodus is the Biblical command from which the Hebrews developed their Laws of Terephah; these laws give the conditions that render animals unacceptable for food. As contained in the Talmud, they constitute a sort of codification of traditional oral law which developed over many centuries of early Hebrew culture. These terephas or trefas, as the word is used today, are considered by the Hebrew ritual as defects which would make an animal affected by

FIG. 1.—Hebraic characters signifying kosher.

one or more of them subject to Biblical proscription. Originally, there were 18 kinds of trefas in the Mishnaic portion of the Talmud re-dated about 200 A. D. These were later grouped into 6 major categories. This is mentioned as an example of how detailed the interest of a people can become in the meat portion of its diet.

Alongside the negative law of trefa developed quite logically the positive law of kasher. Today, the word kosher is used, meaning ritually clean. It is significant that these so-called laws of trefa and laws of kosher have become so firmly established and so interwoven with the culture of the Hebrew race that they are still retained as part of the ritual of Hebrews residing in this country today. Rabbi and Rabbinical representatives are present in many meat packing plants for the purpose of determining whether meat which is intended to be merchandised in the Jewish trade meets their ritualistic requirements. That meat which is found to be acceptable to them is marked with the characters shown in figure 1.

Medieval Florentine. There comes to us in connection with the history of Florentine Guilds, specifically, the "arte de 'Beccai'" or the Guild of Butchers, some information concerning controls exercised by Renaissance Florentines over their meat supply. It appears that, originally, the slaughtering and merchandising of meat in the city of Florence were pretty much monopolized by rich and powerful landholders who controlled large grazing lands. In spite of their effort to eliminate the middleman or local butcher from the meat merchandising field, as civil life became more complicated in that ancient city, butchers, as a class of artisans, came into being and this class eventually became a powerful guild.

Concurrent with this development, it became necessary for the city of Florence to pass laws aimed at the correction of unsanitary and fraudulent practices employed by some members of this guild. It appears that the guild members were not only very capable meat merchandisers but, judging from the number of law suits, they must have developed a certain amount of ability to defend themselves successfully in the courts.

The laws enacted by the city of Florence during the thirteenth and fourteenth centuries had a four-fold effect. They required that all butchers annually renew their licenses and at the same time pledge themselves to observing the law of the land. These laws prohibited many kinds of fraudulent practices consisting principally of misrepresentations and substitutions. They prohibited unsanitary practices, such as carelessness in the disposal of offal and unclean premises, and fined unskilled and untidy workmen. They also provided for appointing expert inspectors whose duty it was to detect and bring to court instances of fraud or other irregular practices prohibited by law.

This pattern of meat control served as a forerunner of the science of meat hygiene as it has developed in our western civilization. There only remained to fit into this scheme the science of veterinary medicine and adapt to current needs the controls relating to sanitation, adulteration, and misrepresentation. This has been, in fact, very effectively applied in some European countries for many generations.

American. The early settlers of this country brought with them the customs of their parent countries. Their desires, however, as they relate to meat controls, were not felt until the country had become well-settled and commercialized. The farm slaughterer served the meat needs of this country for many generations. Slaughterhouses did not become a factor in the public meat supply until the population increased and people congregated in large communities. This came about as a gradual development, and while the desire of the consuming public for a clean and wholesome meat supply has always existed in this country, the need for governmental control to realize that desire did not develop until comparatively recently.

By contrast with the European slaughterhouses whose production supplied primarily the local need, in the United States large slaughtering centers developed from which meats are shipped great distances. This happened quite naturally in view of the large livestock-producing areas being several hundreds of miles from the large meat-consuming sections of the country. The advent of the refrigerated railroad car made it possible

to slaughter meat animals many hundreds of miles from the localities in which the meat was to be consumed. These large slaughtering centers also supplied the principal volume of meat that was exported from this country. During the latter part of the nineteenth century attention was focused on the need for applying controls to assure that principles of meat hygiene would be observed in the slaughterhouses. Some European countries threatened to place an embargo against American meats unless an approved system of supervision were provided by the Government of the United States over the slaughtering and meat processing operations of the packing plants preparing meats for export. The first national legislation aimed at applying through appropriate controls the principles of meat hygiene to the meat packing industry in this country was passed in 1890. This legislation, however, applied only to the exportation of food animals and meat from the United States to European countries. A meat packer wishing to engage in export trade would request the United States Department of Agriculture to furnish an inspector for that portion of his output which he intended to export and for which he would request a certificate of inspection for use when he offered his product for entry at the country of destination. Subsequent enactments in 1891 and 1895 improved the inspection control, particularly with respect to the handling of condemned meats.

The growing meat packing industry received considerable adverse publicity following the Spanish-American war and through the publishing in 1906 of Upton Sinclair's book entitled "The Jungle" portraying deplorable conditions in Chicago packing houses. Conditions allegedly prevalent in the meat packing plants became a matter of national concern, with the result that President Theodore Roosevelt made a personal crusade for Governmental control which would apply the principles of meat hygiene to the entire production of meat packing plants engaged in interstate commerce. This brought about the enactment of a comprehensive meat inspection law which was passed June 30, 1906, (page 338, Appendix). The organization of the Federal Meat Inspection Service under this law is covered in Chapter 14.

Chapter

2

ELEMENTS OF MEAT HYGIENE

General.—Meat hygiene is a branch of the larger subject of food hygiene, both having objectives in common. The methods necessary to be used in attaining these objectives for meat differ considerably from those considered to be adequate for most other kinds of food. Animals are subject to disease and other afflictions which make them unfit for use in the preparation of human food. It is not enough that the meat which is offered to the consumer for purchase as food appears to be normal. He expects to get meat which is produced from healthy animals under conditions which will assure elimination of diseased material and freedom from contamination and adulteration. Meat hygiene is distinguished by the methods that are necessary to be employed to accomplish this.

Examinations are conducted of animals intended to be slaughtered for human food for the purpose of eliminating those that are unfit. Diseased carcasses and parts of carcasses are eliminated in connection with examinations made after slaughtering and during the dressing operations. The meat is handled in such a way as to avoid contamination during the dressing of the carcasses; this is accomplished by attention to the separation of the edible portions from the inedible portions to assure their cleanly handling throughout. Supervision over each step in the slaughtering and related operations is provided by a person trained in the principles of meat hygiene and who owes responsibility to the consumer rather than to the meat processor.

It is common knowledge that the application of the principles of meat hygiene cannot be entrusted to butchers and similar personnel employed by packing houses since they are primarily concerned with production problems, profits, and other interests not always consistent with good practices of food handling. Furthermore, animals and slaughterhouses being what they are, it is imperative that each step in the dressing of the carcass and related activities receives the personal attention of a trained inspector.

Ante-Mortem Inspection.—The health of the animals is of initial concern. Examinations are made of each animal prior to slaughter for the purpose of eliminating those which are unfit for the preparation of food.

Post-Mortem Inspection.—The carcass of each animal passed for slaughter is examined to eliminate it or any part of it if diseased or otherwise unfit. Many diseased and otherwise unfit conditions affecting animals are not detectable on ante-mortem examination. A careful post-mortem examination is therefore necessary. Possible sources of contamination which attend a dressing operation are eliminated or controlled. Unclean

equipment, hides, skin, feet, diseased materials and the contents of sinuses, digestive tract, uro-genital tract, and the udder are ever-present sources of contamination attending the dressing of carcasses of food animals.

Reinspection.—As the meat leaves the slaughtering department it is only starting on its way to the consumer. Continued inspection supervision is conducted to assure its remaining clean and wholesome during its handling and manufacture into a great variety of food products. This supervision guards against contamination of the meat. It is a control against adulteration and misrepresentation. Also, it eliminates from the food supply meat which is unfit, adulterated, or misrepresented.

Sanitation.—This begins in the livestock pens and is a factor during each step in the handling of food animals, their carcasses, and the meat derived therefrom until it reaches the consumer. This is sometimes referred to as environmental sanitation. As the term implies, attention is given to every detail in the environment where meat is handled. This includes many of the structural aspects of the premises, water supply, sewage disposal, equipment of all kinds, personnel employed in the handling and preparation of the meat, and all similar details making up the environment to which the meat is subjected.

Condemnation and Destruction of Unfit Materials.—The detection of unfit animals, carcasses and parts, and meat products is followed by their immediate condemnation by an inspector, and they are then promptly destroyed for food purposes under his supervision.

Adulteration.—Nothing should be added to the meat during its handling and preparation which might impair its wholesomeness. Neither should any substance be added which is not normal to, or which is not expected by the consumer to be an ingredient of, a particular meat product.

Misrepresentation.—The meat as it is prepared for purchase by the consumer should not bear any mark or label which is misleading. Neither should it be packaged in a way that would be misleading as to its identity, quality, or quantity.

Knowledge of Meats; Their Handling and Their Processing.—In addition to being trained in the principles of meat hygiene, the inspector is given a thorough knowledge of the meat prepared under his supervision and the methods used in the preparation. An effective application of the principles of meat hygiene by an inspector depends on his being able to recognize the normal and to detect and correct deviations therefrom which may be at variance with those principles.

Chapter

3

ANTE-MORTEM INSPECTION

COMPETENT ante-mortem inspection gives the only assurance that unfit animals will be handled in the fertilizer plant rather than processed as food. It is well known that sometimes stock raisers will ship sick animals for slaughter for food. Furthermore, many conditions develop while animals are in transit to meat packing plants which might make the difference between profit and loss in a carload. It is only through the diligence of the ante-mortem inspector that unfit animals and their carcasses are kept out of departments where food animals and their carcasses are handled in the course of their preparation as human food.

Technique. General. In order than the ante-mortem inspection can be conducted properly it is necessary to have adequate facilities. The animals are placed in properly lighted holding pens where the inspector can move freely among them and view them both at rest and in action. Equipment is provided for restraining those animals which the inspector requires to be segregated for closer examination and for such identification as he may consider to be necessary.

The animals that are found to be affected by some abnormal condition come within three classes: (*A*) those that are found to be unfit for slaughter, (*B*) those affected with a localized condition, and (*C*) those with a condition which has not advanced to the point which renders the animal unfit but which might influence the disposition of its carcass on post-mortem examination.

A. Animals found to be unfit for slaughter for food purposes are of two kinds. (1) Those which have reached that condition where treatment is impracticable, in which case they are condemned without sending them to the slaughtering department. They are then disposed of under the supervision of the inspector. (2) Those animals which are found to be affected by some condition which might respond to treatment. Generally, no facilities are provided on the premises of meat packing plants for the segregation and treatment of sick animals. In fact, an attempt to maintain such facilities on the premises may constitute a nuisance and interfere with the maintenance of good sanitary conditions. The treatment of sick animals, therefore, is accomplished somewhere outside of the premises and they are returned to the slaughtering plant only after a complete recovery has been made.

B. Animals affected with local conditions, such as fractures, abscesses, bruises, and the like, are segregated for further examination. This examination is for the purpose of determining the extent of the condition and to

ascertain whether there is systemic involvement. The temperature of the animal is taken, its respiration is noted, and the condition of exposed mucous membranes is observed. The results of this examination are recorded so that they are available when the post-mortem examination of the animal is conducted. The identity of each animal is maintained and it is slaughtered separately from the regular kill so that a more thorough post-mortem examination can be made. These animals are commonly referred to as "suspects." This term is used since the animal, because of the local involvement, is suspected of having a condition which might influence the disposition of its carcass or a part thereof on post-mortem examination. Figure 56 illustrates a metal tag used under Federal meat inspection. It is affixed to the animal's ear as identification. The post-mortem findings are interpreted in the light of the condition found on ante-mortem inspection and disposition of the carcass and its parts is made accordingly.

C. The third group includes animals affected by a condition which has not advanced to the point that would render the animal unfit. Such animals are also designated as "suspects." These animals are also segregated from the animals passed for slaughter on ante-mortem inspection and examined individually before being released for slaughter. The ante-mortem findings concerning their general appearance, temperature, respiration, and appearance of mucous membranes are also recorded so that they may be available when the post-mortem examination is conducted. These animals are also slaughtered apart from the regular kill and a thorough post-mortem examination is conducted on each animal. The ante-mortem condition is considered in connection with the post-mortem findings in finally disposing of a carcass or its parts.

Cattle.—The inspector conducts his ante-mortem examinations by first entering the pen quietly so that he may observe the animals while they are at rest. He notices their general conduct to determine whether they are fatigued, or whether they are resting quietly. Should the animals give the appearance of fatigue, he looks for cases of so-called shipping sickness. He notes the general appearance of each animal, particularly the respiration, which, if quickened, is an indication of some abnormal condition. All abnormal animals found at this stage are segregated immediately and taken to a holding pen equipped with a chute where they are examined individually. The next step is to observe the animals in motion. This means getting them all to their feet and watching them move about. Both sides of the animal are observed so that conditions, such as epithelioma of the eye, "lumpy jaw", and unhealed vaccination, will be detected. Animals so affected, as well as animals which move about stiffly, or are lame, are also removed to the holding pen and examined individually. Milk cows are observed for indications of mastitis. Signs of retained placenta are looked for. The inspector is alert to detect symptoms of such conditions as rabies, anthrax, listerellosis, and tetanus.

Calves.—The ante-mortem examination given calves is similar to that given cattle. The principal difference is the attention necessary to be given young calves to determine whether they have reached that maturity which would permit their being handled as food animals. Young calves which

are too weak to stand up or to move about normally, or that lack normal muscular coordination, are unfit for slaughter. Calves with infected navels with or without joint enlargement are segregated for individual examination to ascertain whether the condition is general or localized. Calves showing systemic involvement connected with navel infection are not permitted to be slaughtered for food purposes. Where the condition appears to be localized, the calf is handled as a suspect.

Swine.—Swine also are observed both at rest and in motion. The respiratory picture of a pen of swine at rest is important as it has a bearing on the general condition of a lot of swine. Care is exercised to distinguish between quickened respiration as a result of recent driving and the condition as it might be an indication of respiratory involvement. In those cases where a lot of swine appears to be affected generally with some respiratory condition, the lot is handled as a unit and examinations are made to determine whether the condition is due to hog cholera or similar affliction. None of a lot of hogs affected with hog cholera is taken to the slaughtering department. The entire lot is removed for treatment and not slaughtered for food until the hogs have recovered from the condition. Where the lot of swine presents no general disease condition, those animals which show any abnormal condition are removed to the holding pen and examined individually. The usual separation into unfit animals and those which are permitted to be slaughtered as suspects is made. Stags and boars are separated from the regular kill and identified for examination for sexual odor on post-mortem examination.

Sheep.—Sheep also are examined both at rest and in motion. Frequently during the warm months of the year individual sheep do not stand up well under shipping conditions. Sheep which are found to be weak are segregated and taken to the holding pen where they can be examined individually. These sheep are then separated into those which are unfit for slaughter and condemned and those which are permitted to be slaughtered as suspects. Sometimes several cases of tetanus will be observed in a lot of recently castrated lambs.

Pathology.—Disease conditions commonly encountered in making ante-mortem inspections are mentioned here. Only a very brief discussion of the pathology of each condition is given since the veterinarian and veterinary student are presumed to be fully informed concerning the pathology of diseases of animals through other courses of study. The discussion in each case is intended to point up the significance of the disease as it relates to the handling of animals during ante-mortem inspection and to their suitability for slaughter for food purposes.

Listerellosis.—This disease is most prevalent in the late winter and early spring, however, it does occur at other times of the year. It affects cattle and sheep principally. Man is also susceptible. It is usually manifested as a disorder of the central nervous system. In ruminants, the disease does not ordinarily sweep through a herd but may affect 10 per cent or less of the animals over a period of several months. Sheep appear to be more susceptible than cattle. The course of the disease runs more rapidly in sheep, and they seldom live more than from forty-eight to seventy-two hours. In cattle, the disease runs for a week or more.

Etiology and Pathogenesis.—*Listerella monocytogenes* is the causative organism. In natural cases of listerella encephalitis in ruminants the organism has been isolated only from the central nervous system.

Symptoms.—A few animals may become violent at the onset of the disease and present a picture similar to rabies. Generally, the infected animal separates itself from the rest of the herd, becoming very depressed and refusing to eat. It will stand against a fence or building as though it needs support. When it walks, it usually travels in circles. The head is sometimes held to one side and facial paralysis sometimes occurs. The temperature may be normal or elevated. Usually there is nasal discharge, and salivation occurs.

Ante-Mortem Significance.—Animals showing symptoms of listerellosis are unfit for slaughter for food. Should the condition be such as to justify treatment, the animal is removed to premises where proper treatment can be undertaken. Animals which have recovered from this disease are passed for slaughter as suspects.

Anthrax.—This disease is rather widespread throughout the United States. Large areas of infection exist in South Dakota, Nebraska, Mississippi, Louisiana, Texas, and California. There are anthrax areas also in Vermont, New Jersey, Delaware, Wisconsin, Utah, Nevada, and Oregon. This disease affects all species of animals as well as man. Sheep and cattle are particularly susceptible, with a high mortality. Hogs are less susceptible; there being a tendency for the infection to localize in the tissues in the region of the throat and neck.

Etiology and Pathogenesis.—The spore-bearing *Bacillus anthracis* is the causative organism. Infection of cattle and sheep takes place through the alimentary mucosa or may result from bites of contaminated insects. In these animals, the disease usually appears as an acute rapidly fatal febrile condition with a terminal bacteriemia. The organism also enters through the mucous membrane of swine but the infection tends to become localized in the adjacent lymph glands.

Symptoms.—Cattle and sheep are usually seen in the advanced stages of the disease. The animal trembles, staggers, and breathes with difficulty. Frequently there are discharges of bloody feces, urine, and saliva. Spasms occur in the final stages of the disease. Generally, anthrax in hogs is localized in the pharyngeal and parotid regions. Swelling of the neck may occur. This is difficult to detect on ante-mortem inspection unless the condition has progressed to the point where there is interference with respiration and swallowing. As the condition progresses toward asphyxiation, the mucous membranes become cyanotic.

Ante-Mortem Significance.—Animals showing symptoms of anthrax are unfit for slaughter for food. Such animals are removed immediately from the premises since they are a dangerous source of infection. The pens and runways in which the affected animals were handled are immediately cleaned of all straw, litter, and manure which are burned. The premises which have been exposed to the infection are then disinfected by soaking the floor, fences, gates, and all exposed material with a 5 per cent solution of sodium hydroxide or commercial lye. The sodium hydroxide or commercial lye should contain at least 94 per cent of sodium hydroxide. The

solution is prepared immediately before being used by dissolving $2\frac{1}{2}$ pounds of sodium hydroxide or lye in $5\frac{1}{4}$ gallons of hot water. To be most effective, this solution is applied as near scalding hot as possible. This sodium hydroxide solution is extremely caustic. The operator uses rubber gloves and boots to protect his hands and feet, and goggles to protect his eyes while performing the disinfection. A weak acid solution, such as vinegar, is held in readiness should any of the sodium hydroxide solution come in contact with the operator.

Animals which have been given prophylactic inoculations with anthrax biologics that contain live anthrax organisms are not slaughtered for food purposes within six weeks of the inoculation, and then only if there is no evidence of disease and there is no evidence of a reaction to the treatment. Those animals which show inflammation, tumefaction, or edema at the site of the inoculation are considered unfit for slaughter until the reaction disappears.

White Scours of Calves. This is an acute, infectious disease affecting very young animals. It is characterized by diarrhea and rapid exhaustion, and it occurs generally in the spring and fall months.

Etiology and Pathogenesis.—The condition is most commonly caused by the *Bacillus coli communis* but it may be caused by any one of several virulent varieties of colon bacilli. The organism attacks the entire digestive tract, producing hemorrhagic inflammation of the abomasum, and to a lesser extent inflammatory changes in the intestines.

Symptoms.—The first symptoms appear within the first few days after birth of the animal. The affected animal becomes depressed and lies down much of the time. Diarrhea appears within a day or two of the infection. It is first yellowish, turning to grayish-white, sometimes foamy and blood-streaked.

Ante-Mortem Significance.—Calves in which the white scours has not progressed to a condition affecting the general well-being of the animal are passed for slaughter as suspects. Where the calf has become so weakened by the condition that it has insufficient strength to walk into the slaughtering department, it is unfit for slaughter for food.

Rabies. Occasionally, rabies is encountered when ante-mortem examinations are made of cattle. All mammalian animals and man and many birds are susceptible to the disease.

Etiology and Pathogenesis.—The condition is caused by a filterable virus. The virus is found in the central nervous system of diseased animals as well as in the salivary glands and in the saliva. Infection occurs usually through the bite of a rabid animal, the virus entering the puncture wounds caused by the bite.

Symptoms.—Affected animals may show unrest, nervous irritability, and an uncommon aggressive behavior. Spasmodic convulsions may appear. The terminal symptom is progressive paralysis followed by death of the animal. In some cases the stage of irritability may be absent or of brief duration.

Ante-Mortem Significance.—Rabid animals are unfit for slaughter for food.

Tetanus. This is an acute, infectious disease occurring sporadically and affecting all animals. However, it is not common to see this condition in cattle and swine on ante-mortem inspection.

Etiology and Pathogenesis.—*Clostridium tetani* is the cause of this disease. Its spores enter the body through soil contamination of wounds. The organism proliferates in contused muscle tissue and blood extravasations. The toxins formed by growth of the organism attack the nervous system.

Symptoms.—The condition is characterized by tonic spasms of the muscles with no resulting impairment of consciousness. The animal becomes stiff and finally is unable to move.

Ante-Mortem Significance.—Animals affected with tetanus are unfit for slaughter for food. Conditions are generally unfavorable for treatment. The better course is to destroy the animal.

Blackleg. This is an acute infectious condition affecting cattle principally and sometimes sheep and goats. It appears chiefly during the warm months.

Etiology and Pathogenesis.—This condition is caused by the blackleg bacillus *Clostridium feseri*. The organism may enter the body through breaks in the skin or from the digestive tract. It localizes and develops, however, at a point where some destruction of tissue or extravasation of blood exists. The growth of the organism results in a local lesion characterized by gas formation and a toxic systemic involvement accompanied with high temperature symptoms. The affected animal is depressed and has a high temperature. The presence of a crepitant swelling in the musculature of a part of the body characterizes this disease.

Ante-Mortem Significance.—Animals affected with blackleg are unfit for slaughter for food. They are removed for treatment or if treatment is impracticable, they are destroyed for food purposes.

Swine Erysipelas. This is an infectious disease of hogs. Three forms are recognized: the acute (septicemic), the urticarial (diamond skin disease), and chronic (arthritic). It has become rather prevalent throughout the midwestern States. The disease is more prevalent during the spring and summer, occurring only occasionally during the cold months. Man is also susceptible to the organism which produces this disease. In man, the condition usually occurs as a local skin infection causing painful red, elevated lesions.

Etiology and Pathogenesis.—The organism *Erysipelothrix rhusiopathiæ* is the causative agent. The infection usually occurs through the digestive tract, taking on the form of a septicemia. Indications are that the organism is not found in the blood stream as the animal recovers from the condition or the condition becomes localized.

Symptoms.—In the septicemic form of the disease, the animal is dull and depressed with a high fever. A characteristic redness usually appears in spots on the abdomen, the axillary region, and the inner surface of the thighs. Urticaria characterizes a more benign form of the disease. Chronic erysipelas occurs chiefly in the form of an arthritis.

Ante-Mortem Significance.—Animals plainly affected with the septicemic form of swine erysipelas are unfit for slaughter for food. Those suspected

of being affected with swine erysipelas or with a localized condition of that disease are handled as suspects.

Vesicular Exanthema.—This condition affects swine and has been seen in the United States only in the western coastal area. It is distinguished from foot-and-mouth disease since it is not transmissible to cattle. It is an infectious, contagious condition but it does not spread so extensively as foot-and-mouth disease.

Etiology and Pathogenesis.—The condition is caused by a filterable virus. The liquid expelled from the vesicles which form on the mouth, tongue, and feet is very infectious.

Symptoms.—Large vesicles form in the epithelial covering of the lips, snout, tongue, and in the skin of the feet between the claws or around the coronary band. Udder and teat lesions may be found on nursing sows. The animals run a high temperature during the formation of the vesicles which subsides as the vesicles break and the resulting ulcers progressively heal.

Ante-Mortem Significance.—Animals affected with vesicular exanthema accompanied by acute or active lesions or an elevated temperature are unfit for slaughter for food. If treatment of these animals is practical they are removed from the premises for the purpose. Otherwise they are destroyed for food purposes. Animals which have recovered to the extent that the lesions are healing and the temperature range is normal are handled as suspects.

Vesicular Stomatitis.—This disease affects horses principally, although natural infection sometimes occurs in cattle and rarely in swine. This distinguishes it from foot-and-mouth disease. Sheep have been infected experimentally. Vesicular stomatitis of cattle is very rarely encountered in making ante-mortem inspection.

Etiology and Pathogenesis.—A filterable virus is the causative agent of this condition. The infection is believed to gain entrance through abrasions or injuries of the mouth and is picked up from contact with infected animals or from infected feed or troughs.

Symptoms.—Vesicles form on the tongue and in the mucous membrane of the lips and cheeks. This is accompanied with high fever and salivation. Generally, vesicles do not appear on the udder or feet. As the temperature returns to normal and the vesicles rupture, the sore surfaces heal readily unless they become affected with a secondary infection.

Ante-Mortem Significance.—Cattle affected with vesicular stomatitis in the acute stages are unfit for slaughter for food. Animals recovering from the condition, with normal temperature and with lesions in the process of healing, are handled as suspects.

Parturient Paresis.—This is a condition of paralysis and loss of consciousness occurring usually at the termination of parturition. It develops much more commonly in cattle than in other species of animals.

Etiology and Pathogenesis.—The cause of the condition is unknown. Certain predisposing factors have been identified with the condition. It is a generally accepted theory that attacks are precipitated by an acute fall in the blood calcium concentration, but the responsible factors have not been definitely determined. The condition usually affects cows that

are especially good milkers and occurs more frequently during the fifth to tenth years of life.

Symptoms.—There is no fever. The attack usually occurs one to three days after parturition. The characteristic paralysis and depressed consciousness are occasionally preceded by a brief period of excitement.

Ante-Mortem Significance.—An animal affected with this condition is unfit for slaughter for food. Should conditions warrant, the animal is removed to a location where treatment can be undertaken. Should recovery be effected, the animal is handled as a suspect.

Railroad Sickness.—This condition, which is similar to parturient paresis in many respects, affects cows which are usually in the advanced stages of pregnancy and occurs during or after a long continued transportation by rail.

Etiology and Pathogenesis.—The cause of this condition is also unknown. Since it occurs invariably in the animal being shipped for long distances in a standing position in a crowded, hot railway car, such handling of the animal may be regarded as responsible for the onset of the attack.

Symptoms.—The condition develops progressively from an attitude of unrest to an uncoordinated condition associated with a staggering gait. Consciousness is gradually lost. The animal presents a picture very much like parturient paresis.

Ante-Mortem Significance.—Animals affected with railroad sickness are unfit for slaughter for food. Where practical, they are removed for treatment which, if undertaken promptly, is usually successful. Animals that have recovered from this condition are handled as suspects.

Epithelioma of the Eye.—This condition is most commonly encountered in cattle and consists of a carcinomatous involvement of the orbital region.

Etiology and Pathogenesis.—The cause is not definitely known. Lack of pigment in the ocular mucosa of certain breeds of cattle and irritation by sand and other irritants are believed to be predisposing factors. The carcinoma begins in the mucosa of the lower lid or in the membrana nictitans from which it extends into the entire orbit, surrounding bone, and adjacent region.

Symptoms.—There are considerable swelling and inflammatory changes as the condition develops. Areas of necrosis form and there is considerable discharge from the lesion. Metastasis to the parotid region frequently occurs.

Ante-Mortem Significance.—Animals affected with this condition are considered unfit for slaughter for food when the eye has been destroyed or obscured by neoplastic tissue showing extensive infection, suppuration, and necrosis, or if the condition is accompanied with cachexia. Animals affected with this condition to a lesser extent are handled as suspects.

Actinomycosis and Actinobacillosis.—These conditions are considered together because they present a very similar ante-mortem picture even though they are produced by two different organisms. These conditions are seen in cattle. They are both transmissible to man.

Etiology and Pathogenesis.—Actinomycosis is caused by the "ray fungus", *Actinomyces bovis*. Actinobacillosis is caused by the organism *Actinobacillus lignieresi*. Actinomycosis usually affects the bony structures

of the head, especially the mandible, whereas actinobacillosis usually affects the soft tissues in this area, such as the tongue and lymph glands.

Symptoms.—The conditions are characterized by enlargements occurring in the cervical region in the form of large abscesses which may or may not be discharging pus when seen on ante-mortem inspection. When the condition affects the bone there is also considerable enlargement of the area with or without discharge.

Ante-Mortem Significance.—Animals affected with these conditions are handled as suspects unless the condition is accompanied with cachexia, in which case the animal is unfit for slaughter for food.

Shipping Fever. This condition is sometimes called hemorrhagic septicemia and affects both cattle and sheep. It is commonly associated with the hardships experienced by livestock during shipping, and inclement weather appears to be a predisposing factor.

Etiology and Pathogenesis.—The hemorrhagic septicemia organism probably plays a secondary role; the nature of the primary infective agent is not known but is thought by some to be a virus. Shipping fever in many respects resembles influenza-type virus diseases.

Symptoms.—The onset of the condition is rapid. Affected animals show an elevation of body temperature ranging from 104° to 107° F. The condition is characterized by general depression of the animal and distressed breathing accompanied with a hacking cough, swollen, watery eyes, and a mucopurulent discharge from the nose. Swelling may appear beneath the skin of the head, throat, or dewlap. The tongue is often extensively swollen and, because of the irritation of its tongue and throat, the animal drools and slobbers. Shivering and muscular trembling may be evident. Small hemorrhages may be seen in the mucous membrane of the nostrils. The condition sometimes develops into pneumonia.

Ante-Mortem Significance.—An animal in the acute stages of this condition is unfit for slaughter for food. It may be removed to a location where treatment can be undertaken. An animal which has sufficiently recovered is handled as a suspect.

Selenium Poisoning. This condition is sometimes called "alkali disease" and affects livestock which eat selenium-contaminated feed. The principal areas of seleniferous soils which produce plants of excessive selenium content are in South Dakota, Montana, Wyoming, Nebraska, and Kansas. Other States in the Great Plains and Rocky Mountains contain a few of these areas.

Etiology and Pathogenesis.—The excessive amount of selenium in grain or forage grown on seleniferous soils is the cause of the so-called "alkali disease." The condition is manifested principally by its effect on the hair and horn producing tissue. Removal of animals from selenium-contaminated feed is corrective of the condition.

Symptoms.—There is an alteration in the growth of horns and hoofs, and a loss of hair from the switch of cattle and from the back of swine. Affected swine show a general scarcity of hair but this is most marked along the back, the shoulders, and the hips. The tissue in the region of the coronary band from which the hoof develops becomes swollen and in some cases appears to have lost its ability to produce horny tissue.

Ante-Mortem Significance.—Where the animal is so affected as to indi-

cate that it had not been removed from the selenium-contaminated feed for sufficient time to bring about a correction of the condition, it is unfit for slaughter for food. If, however, the animal appears to be in good health and shows a tendency toward the return of its hair coat and new horny tissue is evident above the abnormal hoof condition, it is passed for slaughter but handled as a suspect.

Fluorine Poisoning (Fluorosis). Fluorine is a cumulative poison. It is widely distributed in nature in soil, rocks, water, and plants. Concentrations of fluorine in the soil sufficient to contaminate grain and plants grown thereon have been reported in parts of Arkansas, California, South Carolina, and Western Texas. The principal source of trouble with fluorine poisoning has been in connection with feeding mineral mixtures containing natural phosphatic limestone or rock phosphates which are usually high in fluorine. Poisoning of livestock has also occurred from eating vegetation contaminated with fluorides in the vicinity of aluminum manufacturing plants.

Etiology and Pathogenesis.—Fluorine has a marked affinity for calcium and its toxic effect in the animal body is probably due to its interference with normal calcium metabolism. A high calcium diet apparently tends to lessen the retention of fluorine. Fluorine poisoning is characterized by bone atrophy, abnormally structured osseous tissue, and irritation of the gastrointestinal tract.

Symptoms.—Generally, the symptoms consist of abnormal teeth and bones, stiffness of joints, loss of appetite, and emaciation as the condition progresses.

Ante-Mortem Significance. An animal affected with fluorine poisoning is unfit for slaughter for food. It may be removed for treatment which would contemplate placing it on feed not contaminated with fluorine. Such treatment permits gradual elimination of fluorine concentration in the animal; however, the bone and teeth developments are not reversible. An animal which responds to treatment is passed for slaughter but handled as a suspect.

Hyperkeratosis. This condition is sometimes referred to as "X" disease of cattle. It was first reported in the United States in 1939 in New York State. It has been reported as occurring only in cattle.

Etiology and Pathogenesis. The cause of the condition is not determined. Surveys indicate that it is not due to a specific poisonous plant. It is possible that more than one causative agent goes to make up the "X" disease complex. The condition is characterized by hyperkeratosis involving the skin, muzzle, and inside of the mouth. The areas of skin most commonly affected are those between the hind legs, behind the ears, and sides of the neck and shoulders extending over the sides of the animal.

Symptoms. The skin becomes hard, thick, and wrinkled, sometimes developing wart-like protuberances or proliferations. Such proliferations also sometimes occur on the muzzle, inside the cheeks, and on the tongue, palate, and gums. Ulceration of the mouth and skin may occur due to secondary infections.

Ante-Mortem Significance. When the condition has progressed to the point where the animal shows systemic involvement, cachexia, or emaciation, it is unfit for slaughter for food. If the condition appears to be localized, the animal may be passed for slaughter but handled as a suspect.

Chapter

4

POST-MORTEM INSPECTION

THE inspection that is conducted in the slaughtering department is usually referred to as the post-mortem inspection. However, the examination of the carcass, its organs and other viscera which constitutes the post-mortem inspection is only part of the responsibilities of the inspector in the slaughtering department. Inspection procedures in that department are so organized as not only to provide a thorough post-mortem examination but also to eliminate contamination of meat during each step of the intricate slaughtering operations.

Technique.—**General.** Diseased carcasses and parts are detected by the inspector and they are destroyed for food purposes under his supervision. The handling of diseased material incident to its disposal is so done as to avoid contamination by it of meat which is being prepared for food. Neither is the diseased material permitted to contaminate any equipment in which meat is handled or with which any meat may come in contact. Similarly, the separation of edible portions of the carcass from inedible portions is accomplished without contaminating the edible portions. For example, the gastrointestinal tract is removed from the carcass without any of the contents of that tract coming in contact with or in any way contaminating the carcass meat. What is more difficult to accomplish, the edible portions of the gastrointestinal tract are separated from it without being contaminated by its contents. The inspector in the slaughtering department, therefore, not only detects lesions of animal diseases and has a knowledge of their significance concerning the disposition of the carcasses which he inspects, but he supervises personally the dressing of each carcass to assure that at each step in the operation every precaution is taken to preclude contamination of the meat.

The construction of the slaughtering department, its equipment, and the layout of the department bear a direct relation to the maintenance of sanitary conditions there. In spite of the best efforts of an inspector, good results are not possible where there is faulty construction, inadequate equipment, or poor layout. The slaughtering department is constructed so as to facilitate the maintenance of clean conditions. There is sufficient and properly designed equipment to permit efficient and clean operations and to permit the slaughtering department being readily cleaned. The layout is such as to assure smooth flow of operations. Adequate light, both natural and artificial is provided. Good light is important not only as a necessity for the conduct of the inspection but it also makes easier the maintenance of a clean condition throughout the entire department. Facilities are provided for periodical cleanups during the slaughtering operations.

The equipment necessary for proper handling of the carcass and its products during the slaughtering operation is quite specialized. For example, it is necessary that the hog scalding vat be supplied with hot water at just the proper temperature for scalding the hog carcass effectively. This vat is the correct length considering the rate of kill, to permit submerging the carcass long enough to get the desired results. Also, this vat is so installed and located that the steam from the large quantity of hot water which it holds will not interfere with normal slaughtering operations, inspection procedures, and the like. As another example, the rails

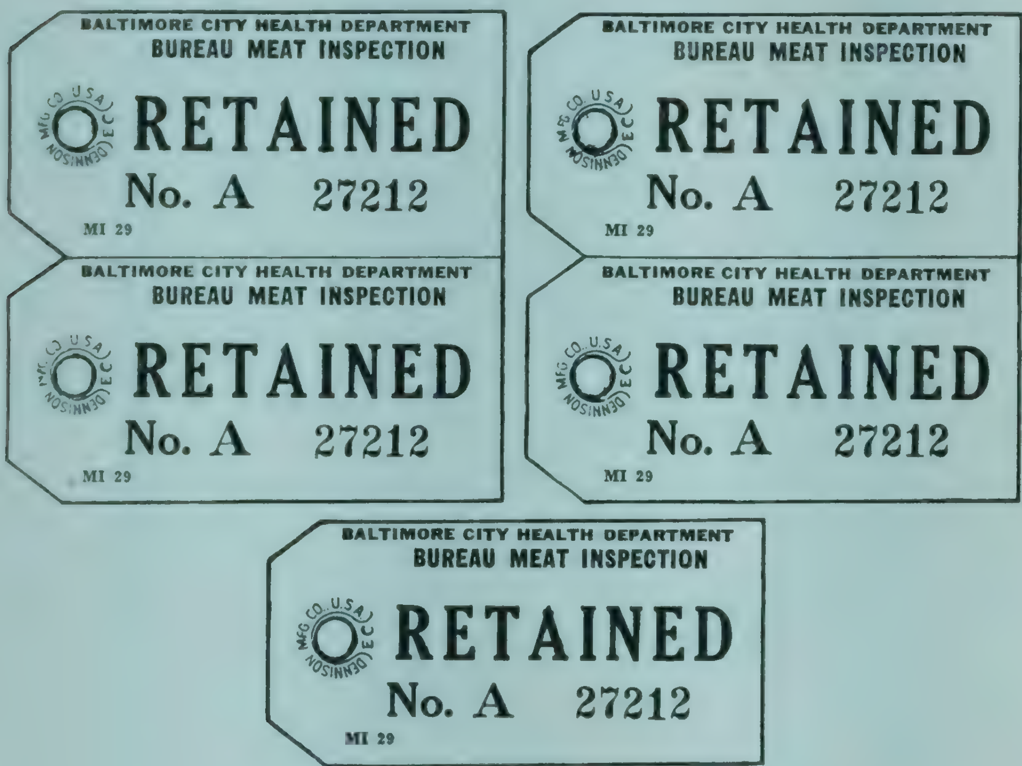

FIG. 2.—Gang of five "Retained" tags.

for conveying the hog carcass through the slaughtering operations are of the right height with respect to the operating levels, so as to facilitate the efficiency of each dressing operation performed on the carcass while it is suspended from the rail, and at the same time avoid contamination of the carcass which would occur should it come in contact with the floor or other fixed objects. Structural details which have a bearing on the sanitary operation of a meat packing plant and the facilities for inspection are dealt with in chapters 7 and 8.

Post-mortem inspection of food animals is based on the routine examination of the head and cervical lymph glands, the visceral and body lymph glands, the organs of the viscera, and the exposed portions of the carcass. A more minute examination is made of the organs and parts of carcasses depending on the condition found during the routine examination or when the carcass is that of an animal identified as a suspect on ante-mortem inspection.

When a disease or other abnormal condition is found during the routine post-mortem examination, the carcass and its parts are retained for a final examination which is more extensive than would otherwise be given the carcass. Tags bearing the word "retained" are affixed to the various portions of the carcass and its viscera which become separated during the dressing operation so that they may be assembled for the final examination. In the case of cattle retained for final examination, a so-called gang tag is used consisting of 5 identical "retained" tags each bearing

FIG. 3.—An unfit hog carcass being branded "U. S. INSP'D AND CONDEMNED."

the same serial number. One tag is attached to the head, a tag is attached to each half of the carcass, and one is used to identify the viscera. The remaining tag is held by the inspector as a record of the retention. For final examination all portions of the carcass and its viscera are assembled in a space set apart in the slaughtering department especially for this purpose.

In those cases where the abnormal condition is benign and localized and one in which there is every reason to believe there is no similar in-

volvement anywhere else in the carcass, the inspector disposes of the localized condition summarily. If no other abnormal condition is found during the inspection, the normal portions of the carcass and its parts are passed for food without requiring it to be retained for final examination.

Carcasses, parts of carcasses, and accompanying viscera which are found to be unfit for food are condemned by the inspector and under his supervision are made unavailable for food by placing them in the fertilizer tank or by similar handling.

Cattle.—Two methods of slaughtering cattle are employed in the United States; both rely on complete bleeding of the animal. The one generally employed accomplishes bleeding of the animal through a stick wound in the lower part of the neck which severs the blood vessels in that region. The animal is stuck after having been knocked unconscious by a blow which usually fractures the skull over the brain. In the other method the bleeding is accomplished by drawing a sharp knife transversely across the upper portion of the underside of the neck severing the blood vessels. In this case the animal is not stunned before bleeding; this is the so-called kosher method. The animal, in each case, is shackled by one or both hind legs and held in a suspended position well above the floor until completely bled.

Stunning of cattle is universally accomplished in the United States with the use of a long-handled hammer. A captive bolt pistol is commonly used in England and from time to time efforts are made to introduce this equipment into the United States. The captive bolt pistol is similar to an ordinary pistol in appearance. In the barrel is a sliding rod or captive bolt which is free to move to and fro but cannot leave the barrel. Explosion of a small blank cartridge drives the bolt into the animal's head. The bolt is withdrawn into the pistol automatically through the action of compressed air which develops in the barrel during the forward movement of the bolt. The bolt normally penetrates into the skull from 2 to 3 inches. When the bolt penetrates through the skull and into the brain it sometimes carries with it particles of skin and hair. Brains so contaminated are regarded as being unfit for food.

If blood is to be saved for use as human food, there is provided a covered container having a spout, the end of which is inserted into the stick wounds and diverts the blood into the container. In order to prevent coagulation of the blood in the container, a solution of one part of citric acid or sodium citrate in two parts of water is first placed in the container. Only a small amount of this solution is required and it is not used in an amount to exceed 0.2 per cent of the solution in the amount of blood to be saved. To use more of the solution than is necessary to accomplish the purpose is considered adulteration.

Possible sources of contamination of the blood are from the hide and the probability that the esophagus may be punctured or severed by the incision. The receptacle for catching the blood is therefore completely enclosed except for the spout which is inserted in the incision beneath the cut surfaces of the skin. The esophagus is invariably severed when the kosher method of bleeding is used. In this case, if edible blood is to be saved, a heavy pair of forceps is clamped over the cut end of the esophagus

on the paunch side to prevent regurgitation which sometimes occurs while the animal is bleeding. The blood of each animal is identified with its carcass so that should any condition subsequently be found on post-mortem examination of the carcass which would require its condemnation, the blood can then also be destroyed.

After the bleeding of the animal and while the carcass is still hanging from the chain shackled around the hind legs, the head is skinned and removed from the carcass. This skinning is conducted with the care necessary to avoid contamination of its skinned surface by the hide. For the same reason the skinned head is removed promptly from the carcass. As the skinned head is severed from the carcass, it is held securely by the operator so that it is not contaminated by contacting the floor. As the head is removed from the carcass, there is attached to it one section of a two-section identification tag, the other section being attached to the neck of the carcass. This maintains the identity of the head with the carcass since the disposition of the head finally will be determined by the condition of the carcass found on post-mortem examination and its final disposition.

The skinned head is then placed on a rack or a hook located in a cabinet directly connected with a drain. This cabinet controls all splashing which occurs while the head is being cleaned by washing with water under high pressure. At this point the horns are removed from the head. Particles of skin which might have been missed in the skinning and left adhering to the head are also removed. The outside surfaces of the head are thoroughly cleaned, and the oral, nasal, and pharyngeal cavities thoroughly flushed of their contents. The washed head is then placed on a hook or a rack which separates it from the other heads to facilitate its inspection.

The inspector first examines the head to see that it has been properly cleaned. At the same time he detects any abnormal condition on the outside surfaces of the head, such as enlargements, abscesses, and the like. He then exposes and examines by incising repeatedly both mandibular lymph glands. These glands are located superficially in the lower portion of the mandibular space between the inner aspects of the mandible and the mandibular salivary glands about 2 inches anterior to the point where the lower border of the mandible curves abruptly upward and above the anterior attachment of the sterno-cephalicus muscle. Usually, there is but 1 gland on each side but at times there are 2 glands lying very close to each other (Fig. 4). To expose the gland, a longitudinal incision is made along the inner border of the sterno-cephalicus muscle just within the lower border of the mandible where the gland will be seen adjacent to the salivary gland.

The suprapharyngeal lymph glands are next exposed and examined by making repeated incisions in the glands. These lymph glands are located at the base of the cranium just superior to the pharynx lying close together on each side of the median line between the branches of the hyoid bone (Fig. 4). These glands average about 2 inches in length. They are exposed by first drawing the larynx forward and downward and then a deep transverse incision is made near the base of the cranium. This will reveal the glands lying on the superoposterior surface of the pharynx.

The plant employee removes the thyroid glands and the parathyroid

glands before he proceeds with dropping the tongue which prepares the head for further inspection. These glands are saved for the production of pharmaceuticals. The thyroid gland consists of two maroon-colored

Fig. 4.—Bovine head in position for inspection (lymph glands exposed).
A, Mandibular lymph gland; *B*, parotid lymph gland; *C*, suprapharyngeal lymph gland; *D*, atlantal lymph gland; *E*, hemolymph gland.

masses on either side of the trachea and close to the larynx. These masses are bridged by a narrow isthmus of the same tissue. The parathyroid glands are located near the thyroid gland. The number found in individual animals varies considerably. These glands are sometimes imbedded within the substance of the thyroid gland and sometimes directly behind it on the trachea. They are about the size of a wheat seed.

The tongue is dropped by first severing the hyoid bones with a cut made by a cleaver transversely at the base of the cranium. The tongue is then cut free from the base of the cranium and the interior surfaces of the mandible, leaving it attached at the symphysis of the mandible from which the tongue is permitted to hang free. The tonsils are removed from the base of the tongue and disposed of as inedible. Occasionally, cut portions of the tonsil are left remaining on the skull when the base of the tongue is removed from it. These particles of tonsil are trimmed from the skull and discarded as inedible to avoid their being included with the head meat when the head is boned.

The inspector examines the tongue for abnormalities by observing its surface and by palpation. Local conditions, such as scars and hair sores, are trimmed from the tongue. Abscesses are detected by palpation.

The inspector slices the interior and exterior masseter muscles parallel to the plane of the mandible, to their attachments at the zygomatic process. The cut surfaces of these muscles are examined for parasite cysts. The parotid lymph glands are repeatedly incised for examination as part of this operation. The parotid lymph gland is located at the superior anterior border of the parotid salivary gland being partly imbedded in the salivary gland and partly lying on the masseter muscles about 1 inch in front of and a little lower than the external meatus of the ear (Fig. 4).

The head which has passed inspection is held until post-mortem examination of the carcass is completed. When the carcass also passes the inspection, the head is removed from the inspection position to the point where it is worked up by the plant employees. The tongue is first removed and each tongue is washed individually before being placed in the truck or other container which conveys the tongues to the cooler.

After the tongue is removed any meat and fat left on the skull is trimmed from it. This is known as head meat. The meat and other tissue removed from the interior and exterior surfaces of the mandible are referred to as beef cheeks. When these cheeks are trimmed by removing the parotid salivary gland, and lymphoid, and fatty tissue, the resulting product is called cheek meat. The soft palate and lips are also removed and saved as edible product.

The skull is split and the brain removed. The pineal and pituitary glands are removed from the base of the brain and saved for pharmaceutical purposes. The pineal gland is a cone-shaped bit of tissue hidden away at the base of the brain in a tiny case behind and above the pituitary gland. The pituitary gland is located at the base of the brain. It is about the size of a hazel nut and of pinkish color. It consists of anterior and posterior lobes.

After the head is removed the carcass is lowered to the dressing bed where it is placed on its back and is propped up either by a short iron rod called a "pritch" or by using a cradle.

The legs are skinned and removed from the carcass at the carpal and tarsal joints. The legs are all removed after the carcass is placed in the dressing bed, since an attempt to remove the forelegs while the carcass is suspended from the bleeding rail opens up the shank and carpal regions to probable contamination as the carcass is lowered into the bed. The

preferred practice in skinning the legs prior to their removal is to leave the dewclaws attached to the skin, which avoids the accumulation of detached dewclaws in the dressing bed area.

After the legs are removed, the carcass is opened by cutting along the median line from the neck through the crotch. This incision is deep enough to open the abdominal cavity. In opening the carcass, care is exercised to avoid puncturing the paunch, intestines, or bladder, since their contents would constitute a serious source of contamination. The esophagus is raised, separated from the trachea and it is then ligated so as to prevent escape of the paunch contents during subsequent handling. The trachea is likewise loosened from its natural attachments so that its removal with the lung will be easy when the carcass is eviscerated.

The skinning of the ventral surface of the carcass progresses at this point and includes the skinning of the shoulders and the thighs. The principal source of contamination during this operation is connected with the removal of lactating udders. Care is exercised to leave the skin in the area of the teats intact, and the skin is removed from the udder without puncturing the glandular tissue. After being skinned, the udder is removed from the carcass and here again care is exercised to avoid puncturing the glandular tissue. Furthermore, removal of the udder is accomplished leaving the supramammary glands intact and attached to the carcass. The pelvis is opened at its symphysis and the thorax is opened by sawing through the brisket on the median line. In sawing the brisket, the point of the saw is directed toward the neck rather than toward the abdomen. This is done to avoid contamination which might result from the saw puncturing any of the viscera or contacting any disease process, such as an abscess in the liver.

The carcass is next raised slightly off the floor by the back legs to a position known as "half hoist." This position leaves the shoulders resting on the floor and places the carcass at the proper height for the plant employee to remove the hide from the rump. The first step in this skinning operation is to clear out the hide around the rectum. Care is exercised to avoid puncturing the rectum, and after it is separated from the hide and loosened from the walls of the pelvic cavity it is ligated to avoid contamination which would result from escape of its contents. The tail is skinned out next and this must be done carefully to avoid contamination of the surface of the skinned tail by the hide and hairs as the skin is removed. After the rump is skinned, the carcass is raised further to hang free of the floor so that the viscera can be removed and placed in appropriate equipment for inspection.

The viscera is separated into the thoracic viscera, the paunch including the other stomachs, and the intestines. As the stomachs are removed from the intestines, both ends of the cut duodenum are ligated to avoid escape of its contents and possible contamination. As the viscera is presented for inspection the lumen of the intestinal portion has been tied off at the duodenum and again at the rectum and the stomach portion has been tied off at the esophagus and duodenum.

Routine inspection of the viscera starts with an observation of its general condition. Then the bronchial lymph glands are incised repeatedly and

examined for indication of disease. The right bronchial lymph glands are about four in number and are located at the juncture of the bronchus of the right apical lobe and the juncture of the main lobe with the trachea. The left bronchial lymph gland is located on the left side of the trachea anterior to and near the left bronchus and is normally the largest of the bronchial lymph glands. The posterior mediastinal lymph glands are then incised repeatedly and examined. These glands extend from the aortic arch posteriorly to the diaphragm. They consist of two main groups. The anterior is the smaller group sometimes called the medium mediastinal glands. The lymph glands of both groups vary in size.

Fig. 5.—Thoracic viscera of cattle.
A, Bronchial lymph glands (right and left); *B*, mediastinal lymph glands.

The lungs are palpated to detect any abnormal condition that may be present.

The heart is next examined by making in it a longitudinal incision extending from its base to the apex through the wall of the left ventricle and the interventricular septum. The outside and inside surfaces of the heart are then examined as well as the cut surfaces to detect any indication of the presence of parasite cysts.

The liver is then examined by first observing and incising repeatedly the portal lymph glands. These glands, from three to five in number, are

located on the posterior surface of the liver and are imbedded in the fatty cushion surrounding the vessels entering at the portal fissure. The large bile duct is then opened longitudinally and examined for indications of parasitic infestation. The liver is palpated for the purpose of detecting any abnormal condition whether located superficially or deeply in the organ.

FIG. 6.—Federal veterinary meat inspector demonstrating inspection technique on bovine viscera for students attending a class on food hygiene conducted by the U. S. Navy. (Official United States Navy Photograph.)

The remainder of the abdominal viscera is then examined by first observing the mesenteric lymph glands. These are incised in case an abnormal condition is found. The mesenteric lymph glands are located in the mesenteric fat along the lesser curvature of the intestines in the folds of the mesentery and consist of a continuous chain of glands from the abomasum to the cecum. They are cylindrical segments and vary in size and consistency according to the stage of digestion, being more voluminous and containing a greater fluid content immediately after or during the

digestive period. The spleen is palpated and incised when necessary for a complete examination.

Attention is given to the external surface of the reticulum since abscesses caused by punctures of foreign bodies in that organ frequently occur.

Following evisceration, the hide is removed from the back of the carcass as far as the shoulder region or "chuck." The rump and back are then split and the carcass is elevated to the overhead rail on which it travels eventually to the cooler. The hide is next removed from the shoulder and neck and dropped to the floor. The chuck and neck are split and the carcass hangs in two halves or sides. The hide is removed to a conveniently located chute through the floor which conveys it to the hide cellar. Care must be exercised to see that the hide is handled in such a way as not to contaminate any edible portions of the carcass.

The last dressing operation before the halves move to the rail inspection position and final washing is known as "scribing." This consists of breaking the dorsal processes of the vertebræ along a line parallel to the back starting on the second vertebræ of the loin about three-fourths of an inch from the dorsal surface, downward across the dorsal processes of the thoracic vertebræ on a slight angle. This is done for the purpose of improving the appearance of the sides.

Each side of the carcass is next examined at what is referred to as the rail inspection position. The term "rail" is used to designate the inspection conducted on each carcass as it hangs from the rail. It consists of observing all surfaces of the carcass and includes palpation of the prescapular, prefemoral, superficial inguinal (supramammary), internal iliac, lumbar, and renal lymph glands. The prescapular lymph gland is located a little above and inward from the shoulder joint imbedded in a cushion of fat and covered by the brachiocephalicus muscle. It is a large gland and elliptical in shape. The prefemoral lymph gland is situated on the aponeurosis of the obliquus abdominis externus muscle, in contact with or close to the tensor fasciæ latæ and 5 or 6 inches above the patella. It has an elongated elliptical outline and is flat. The superficial inguinal lymph glands are located at the neck of the scrotum beside the penis in front of the inguinal ring; they are imbedded in the scrotal fat in castrated males. The supramammary lymph glands are situated bilaterally at the posteriosuperior part of the mammary gland. The internal iliac lymph glands are large heart-shaped glands 2 or more inches in diameter located in about the upper third of the pelvic arch in the obtuse angle formed by the external iliac artery and the abdominal aorta. The lumbar lymph glands are located in the sublumbar region along each side of the abdominal aorta and are usually imbedded in the fatty cushion bordering the large blood vessels of the sublumbar region. The renal lymph glands are located in the fatty tissue in the hilus of the kidney on the course of the renal artery.

The region of the kidney and the crura and flat portion of the diaphragm are observed and palpated. The pelvic cavity is observed, particularly, to make certain that no portion of the genitalia has been left remaining on the carcass.

Those carcasses which pass inspection at this point and which have not

been retained for any condition on previous inspection are thoroughly washed, and then they are ready for the cooler. After being washed and before being placed in the cooler, many meat packing plants clothe the external surface of each beef side. The side is covered with a warm, damp sheet of heavy muslin (40 inches wide, 48x48, 2.85 yards to the pound). This cloth is stretched tightly around the thigh and down over the flank and outside surface of the carcass, being securely pinned along the cut median line and the vertebral column. The cloth is removed from the side after chilling, giving it a smooth and bleached appearance. Before these cloths are used again, they are washed thoroughly by first soaking to remove any blood stains, laundered, and then treated with a solution of sodium hypochloride to accomplish a degree of sterility.

After the abdominal and thoracic viscera have passed the inspection, they are removed to the viscera separating area. The unit referred to as the "pluck", which consists of the lungs and heart, is hung up by the trachea for separating into its various parts. The fatty tissue making up the pericardial sac is removed and saved as edible fat. The heart is separated from the lung and the large arteries are cut away. These arteries are handled as inedible. The trachea is removed from the lung; the trachea is also inedible. If the lungs are to be saved for food, the plant employee opens up the large bronchi by splitting them longitudinally. Lungs so prepared are hung on racks for further inspection. In those cases where any foreign substance is located in the bronchi, the lungs are condemned. The liver and spleen are edible products.

The unit consisting of the stomachs is placed on a table where the first operation performed by the plant employee consists of removing the omental fat which is saved as edible. Next, the rumen and reticulum are separated from the omasum and abomasum. The omasum and abomasum are handled as inedible, while the rumen and reticulum, which together are known as the paunch, are emptied of their contents as the first step in their preparation as tripe. The esophagus is removed and flushed of its contents; the muscular coat is separated from the mucous lining. The muscular coat is known as gullet meat, an edible product. The mucous lining is one of the animal casings and is known as the weasand.

After being emptied of its contents, the paunch is thoroughly washed by spreading it with the mucous side up over a cone-shaped table. A water spray located above this table assists in the thorough scrubbing of the entire mucous surface. This cone-shaped table revolves to facilitate the washing process. The washing continues until the water squeezed from the cleaned surface is as clean as the wash water itself. The paunch is then turned over with the peritoneal surface up. This surface is also thoroughly washed, and trimming of soiled loose connective and fatty tissue is sometimes necessary to completely clean the article.

The cleaned paunches are hung up for inspection before they are scalded. The scalding of the paunches is done primarily to remove the superficial surface of the mucous membrane. This is performed by placing a number of clean paunches in a revolving washer of special design partially filled with hot water to which a detergent has been added. The temperature of the water is approximately 150° F. and the detergents used are caustic

soda, sodium carbonate (soda ash or sal soda), trisodium phosphate or sodium metasilicate or a combination of these substances, or lime, or a combination of lime and sodium carbonate. Hydrogen peroxide is also sometimes used either singly or in combination with one or more of the detergents. The removal of the superficial surface of the mucous membrane is accomplished by the combined action of the detergent solution and the rubbing action produced by the revolving of the cylinder. After the desired result has been obtained, the detergent solution is drained from the equipment and the product is rinsed thoroughly with clean water while the machine is still revolving. This produces the product known as uncooked tripe which is chilled and is ready for further processing.

The unit consisting of the large and small intestines is handled on another table. First, the small intestine is removed from the mesenteric fat by a method which is referred to as "running." This is accomplished by cutting the small intestine loose from the fat which enmeshes it to the point where it joins the large intestine. The contents are promptly stripped free from the small intestine under a spray of water which washes the contents immediately into a drain. This protects the intestine from contamination. The intestine has considerable fat adhering to it at the point on the surface where the intestine was attached to the mesenteric fat. This fat is removed by passing the intestine through two revolving cylindrical brushes. These brushes play against the surface of the intestine and remove the fat. If this fat is intended to be saved for the production of edible rendered fat, care is exercised to see that none of the contents of the intestine which might have remained after stripping enters the receptacle in which the fat is collected and thereby contaminate it. The small intestine is then turned inside out and passed through a machine which removes the superficial mucous surface. Usually the intestines go through a series of these so-called "sliming" machines after which they are taken to the casing department.

The cecum is removed from the large intestine just posterior to the ilio-cecal valve. It is then flushed of its contents, care being exercised to direct the contents directly to the drain so that they will not contaminate the outside of the cecum. The fat is removed and the cecum is then sent to the casing department. The fat, if clean and properly handled, is classed as edible and is used in the preparation of edible rendered fat.

The large intestine is also flushed of its contents. Water is run through the intestine until it comes out free of any indication of intestinal contents. The fat is removed from the large intestine which is then taken to the casing department. This fat, also, if clean and properly handled, is classed as edible and is used in the preparation of edible rendered fat.

Calves. In some meat packing plants, calves are stunned like cattle before shackling and hoisting for bleeding while in other plants they are hoisted and bled without stunning. Whether or not the calf is stunned, it is shackled by one hind leg and hoisted to the rail along which it travels to the bleeding position. The incision for bleeding is made at a point at the right side of the neck just below the jaw, severing the blood vessels there. When the kosher method of slaughtering is employed, the blood

vessels are severed by drawing a sharp knife transversely across the neck just posterior to the angles of the mandible.

There are two methods of dressing calves in the United States. One is with the hide on, the other with the hide removed.

When the carcass is dressed with the hide on and it has been slaughtered by the kosher method, the head is removed immediately after the animal has been bled. This is necessary to avoid contamination of the exposed cut surface of the head which would occur during the washing of the hide as part of the dressing operation. After the head is removed, it is thoroughly washed in a suspended position with the cut surface down so that the water used in washing the skin of the head will drain away from it without contaminating the cut surface. The oral and nasal cavities are flushed and the cut surface of the head is thoroughly cleaned and trimmed when necessary to eliminate any soiled tissue. The head is then placed on a rack or hook for inspection. The inspector observes the head for cleanliness and any abnormal condition and he incises repeatedly the suprapharyngeal lymph glands as part of his examination. The heads are then held until the carcasses pass inspection.

The carcass with head removed in the case of kosher kill or the carcass with head attached in the case of regular kill is then thoroughly washed while it is suspended from the rail by the shackle. Except for the incision made for bleeding and the removal of the head in the case of the kosher method of slaughter, no incision is made in the carcass until the hide has been thoroughly cleaned. This is usually accomplished by washing the hides of the carcasses with water under very high pressure. Also, curry combs are used where necessary to dislodge any dirt. Next, incisions are made dorsal to the tarsus in which the gambrel is inserted and the carcass is hung off from the shackle rail to the dressing rail. The feet are now removed and the carcass is prepared for evisceration.

When the hide is removed as part of the dressing operation, the hind legs are removed immediately after bleeding and while the carcass is hanging from the shackle. The shanks and thighs are skinned. Incisions are made dorsal to each tarsus for insertion of the gambrel and the carcass is then hung off to the rail from which it is suspended on the gambrel. The skinning of the carcass proceeds as it hangs from the gambrel by first skinning the ventral side and, then, by a combination of skinning and pulling, the hide is removed from hip and back. The forelegs have been removed in the meantime and the skin is removed from the shoulder, neck, head (if attached) and dropped to the floor.

The carcass is opened by cutting along the median line from the pelvis to the neck. The rectum is loosened from the pelvic cavity and it is ligated along with the bladder; also, the penis is removed. As part of the preparation of the carcass for evisceration, the thymus gland is dissected away from the neck and left attached to the trachea. The esophagus is loosened and ligated so that it may be readily removed with the abdominal viscera without any contamination which might occur from regurgitated material or result from tearing the esophagus away from its attachment to the rumen.

After the carcass is prepared for evisceration it passes to the inspection

position. If it is a carcass with head attached, the head is first removed and placed on appropriate equipment for inspection. The thoracic viscera, the liver, and the spleen are removed from the abdominal viscera as the viscera is presented for inspection. The eviscerator must exercise every precaution to avoid cutting into any of the abdominal viscera, the contents of which would be a serious source of contamination for the edible portions of the viscera. In handling small calves the stomach portion of the abdominal viscera is not usually separated from the intestinal portion. It is preferred that abdominal viscera be removed intact so that the ligations of the esophagus and the rectum will completely safeguard against contamination by their contents. In large calves when it is necessary to separate the stomach portion from the intestinal portion, ligations are made where the duodenum is to be severed before the evisceration is performed. Routine viscera inspection consists of an observation of all of the viscera as it is presented for inspection. The bronchial, mediastinal, portal, and mesenteric lymph glands are palpated. Also, the heart, lungs, liver, and spleen are palpated and all surfaces observed.

When a condition is found by the head inspector or the viscera inspector which requires additional inspection, the bronchial, mediastinal, portal, and mesenteric lymph glands and the spleen are incised repeatedly as part of their examination. When a condition is found on inspection which requires the final inspection of the carcass, its viscera, and the head, they are assembled in a space set apart and equipped for final inspection.

Carcasses which pass inspection proceed to the cooler after they are given a final washing. The hides of carcasses dressed with the hide on are not washed at this time because of the danger of washing hair into the interior of the carcass. The washing of such carcasses is confined to flushing out the abdominal and thoracic cavities.

The thoracic and abdominal viscera of calves which passed inspection are handled very much the same as has been described for cattle. The thymus gland or sweetbread of calves is an entirely different commodity from the vestige of the thymus gland sometimes obtained from fat cattle. Another difference is the abomasum which is saved from very young calves for the production of rennin. These abomasi are not saved and handled as edible product since such handling would destroy their rennin content. Their content is only roughly removed and then they are salted down and shipped to the plants where they are used as a source of rennin.

Calf heads are prepared for sale in several ways. Some are chilled whole with the skin on without any further preparation. Others are skinned and the whole head chilled and sold as such. Some calf heads are skinned after which the tongue, cheek meat, and brains are removed. In this case, after removing the tonsils, the tongue, the cheek meat, and the brains are saved as edible products while the bones in the skull and jaws are handled as inedible.

Swine.—In the United States swine are not stunned before bleeding. The animals are driven into a shackling pen which handles only several at a time and permits the shackler to work close to the hoist. The shackler secures the shackle chain around the hind leg of each animal holding the free end of the chain as he attaches it to the hoist which elevates each animal

to the bleeding rail. This rail passes through the sticking pen and here each animal is bled through a stick wound which severs the blood vessels in the lower part of the neck. The opening through the skin is kept as small as is possible and consistent with complete bleeding of the animal. This is important to hold to a minimum the contamination of this area with water as the carcass passes through the scalding vat.

The bleeding rail is long enough to permit holding each animal for sufficient time to assure complete bleeding before it is dropped into the scalding vat.

Considerable attention is given to the temperature of the water in the scalding vat, to the length of time each carcass is held in the scalding vat, and to the thoroughness with which the scalding water reaches all parts of the surface of the carcass. This is important since the thoroughness of the subsequent cleaning of the hog carcass depends on the scalding having been properly performed. If the scalding water is too hot, the surface of the skin is cooked which is not productive of a clean, smooth surface. If the water is too cool, the scurf and hair are not loosened which requires their being cut from the surface of the skin, again producing a surface which is not clean and smooth. The ideal scalding temperature ranges from 138° to 140°F. Generally, the length of time that the carcass is permitted to remain in the scalding vat is determined by tests made by the plant employee to determine whether the scurf and hair remove readily from the skin. The carcass is moved about and agitated in the scalding vat to make certain that the scalding water effectively acts upon the folds of skin in the pelvic and pectoral regions.

To maintain the supply of the large volume of hot water required in the scalding vat, recirculation of the scalding water is permitted, provided such water as must be added from time to time is clean and potable. The scalding vat is drained each day after the slaughtering operations and cleaned thoroughly. A fresh supply of clean, hot water is provided at the beginning of each day's operation. The carcass is placed in the dehairing machine when it is removed from the scalding vat. The hair and scurf which were loosened from the skin in the scalding vat are removed in a dehairing machine by friction produced by blades that beat the skin, and as the carcasses are crowded together, by the friction of one carcass upon the other. The carcasses in the dehairing machine are sprayed with hot water which removes the hair and scurf as they are rubbed free from the surface and facilitates generally the cleaning and polishing effect on each carcass.

The hot water used in the first two-thirds of the dehairing machine is recirculated, while the water used in the last one-third of the machine is not used again. All water used in cleaning the hog carcass beginning with the last third of the dehairing machine until the carcass is completely dressed is fresh, clean, potable water.

If the scalding and dehairing of the carcass has been properly performed, it is almost entirely free of scurf and hair as it leaves the dehairing machine. From this point, the carcass suspended from a gambrel inserted in the hind legs proceeds on the dressing rail. It is first singed as part of the final cleaning of the carcass. From the singer, it proceeds to be shaved and is

otherwise thoroughly cleaned before it is offered for inspection and before any incision is made in the carcass for the purpose of evisceration.

A special kind of singeing is performed on carcasses that are intended to be cut into English Wiltshire sides for export. In singeing for the domestic trade, the hair only is burned off without affecting the skin. For the export trade, the outer layer of the skin is scorched.

Some meat packers supplement the work of the dehairing machine with an application of a mixture of rosin and oil to the carcass. This mixture

FIG. 7.—Head of hog in position for inspection (lymph glands exposed).
A, Mandibular lymph glands; *B*, parotid lymph glands; *C*, suprapharyngeal lymph glands.

which consists of approximately 15 per cent of paraffin oil or cottonseed oil and 85 per cent of rosin is held in a steam-heated storage tank. In some meat packing plants this mixture is applied only to parts of the carcass with large brushes. Other plants are equipped to immerse the entire carcass momentarily in the hot mixture. Where the carcass is immersed, precautions are taken to prevent the mixture from entering the mouth and nostrils of the carcass. After the mixture is applied, the carcass is sprayed immediately with cold water which sets the coating. This coating which possesses some elasticity due to the oil content of the mixture is then peeled off by hand from the surface of the carcass, and it takes with it any hair or scurf which was missed in the dehairing machine.

After the carcass has been thoroughly cleaned it passes to the head inspection position. If the head inspector finds that the carcass has been properly cleaned, he proceeds to an examination of the head and the cervical lymph glands. The mandibular lymph glands are incised repeatedly and examined for any abnormal condition. The inspector also examines the tissues exposed during the examination of these glands to detect evidence of cysticercosis, abscess, or other abnormal condition.

After the head inspection has been completed, the carcass moves to the area where it is prepared for evisceration. The rectum is first loosened and ligated to avoid contamination which would result from the escape of its contents during the subsequent handling of the viscera. The carcass is then opened by a longitudinal incision along the median line extending from the pelvic region to the neck. Care is exercised to avoid cutting into any of the viscera as the incision goes through the abdominal wall. Also, the incision must not cut into the prepuce. The incision severs the pelvis at its symphysis and opens the thorax along the median line. Next, the urinary bladder, the uterus, and the penis are removed, care being exercised again to avoid cutting into the prepuce. The content of the prepuce is a serious source of contamination should it be permitted to come in contact with edible portions of the carcass. As they are removed, all of these organs are handled as inedible.

The carcass is now ready for evisceration. The abdominal and thoracic viscera are removed together and intact. They are handled on equipment appropriate for their inspection. Care is exercised during the removal of the viscera to avoid cutting into it at any point which would permit its contents to escape. Also, the viscera is not permitted to become contaminated by contacting the floor or the standing platform used by the eviscerator.

The routine inspection of the viscera consists of palpating the bronchial, mediastinal, portal, and mesenteric lymph glands. Also, the liver, spleen, lung and heart are palpated for the purpose of detecting any condition which is not readily observed on their surface. It is necessary to manipulate the lung and liver so that all of their surfaces can be observed.

In those cases where an abnormal condition is found either by the head inspector or the viscera inspector which requires a more minute inspection, the bronchial, mediastinal, portal, and mesenteric lymph glands, and the spleen are incised repeatedly as part of their examination. In those cases where the condition is such as to require a final inspection, the carcass and

its viscera are moved to an area especially equipped and set aside for the conduct of final inspection.

Carcasses which pass the viscera inspection continue along the dressing rail to the point where they are split. A plant employee removes the kidney from its capsule and leaves it hanging in the carcass which prepares it for the rail inspection. The rail inspector observes all parts of the carcass. He sees that such benign local conditions as bruises, etc., are removed from the carcass by a plant employee. He examines the kidney and the surrounding area for evidence of parasitic infestation. He observes the exposed cut portions of the carcass for evidence of cysticercosis. He observes closely the perineal region for any abscesses or other abnormal condition resulting from castration. He observes the pelvic cavity to make sure that no portion of the genitalia has been left attached to the carcass during the dressing operation. Carcasses which he finds to be affected with some abnormal condition require final inspection and are retained by him for such examination. Those carcasses which pass the rail inspection move on toward the cooler, but first the head, leaf fat (parietal abdominal fat), and ham facings (fat from the inside surface of each thigh) are removed.

A few chilled hog heads are shipped to the trade just as they are removed from the carcass. Most of them are processed immediately. In either case there is no necessity for further cleaning the hog head, since its cleaning as part of the cleaning of the carcass during the dressing operation is calculated to produce a thoroughly clean hog head. Before the head is cut up into its several parts the oral and nasal cavities are flushed thoroughly so as to avoid contamination by their contents. Hog heads are cut up into skull fat, ears, snouts, lips, tongues, cheek meat, head meat, jaw meat, and brains, all edible products. The jaws and skulls are handled as inedible. Occasionally, the whole head is split longitudinally, leaving the skin over the dorsal surface intact. Such heads are then placed in cure. Before these heads are placed in cure the teeth and turbinate bones are removed to avoid them as a source of contamination in the cure.

Hog tongues require considerable attention to eliminate contaminated portions torn by the teeth during the scalding operation. These portions are trimmed from the tongue and handled as inedible. This is usually done at the same time the tonsils are trimmed from the tongue. Threadworms also are occasionally found in the mucous membrane of hog tongues.

After the viscera have been inspected they are passed to a separating table. The lungs are removed and handled as inedible. The heart, liver, and spleen are saved as edible. The heart is opened and emptied of coagulated blood. The opened hearts are then usually put in a tumbler for a brief period to wash them free of any remaining blood. The hog stomach is emptied of its contents and each stomach is washed invididually. The clean stomachs are placed in a machine half filled with water at 120°F., where they are rotated for a period of about ten minutes. The stomachs are then completely rinsed by running fresh water through the machine.

The small intestines are pulled from their attachment to the mesenteric fat. They pull away from the mesentery without leaving any fat adhering to them. The small intestine is immediately stripped of its contents under a spray of running water, using equipment which will dispose of the

intestinal contents without danger of the intestines becoming contaminated with it. After the small intestine is stripped of its contents it passes through a machine which crushes and squeezes the mucous lining from its lumen. The intestine passes through a series of two such machines which are so equipped that the mucous or slime as it is discharged from the casing passes directly into the drainage system. The intestines are then taken to the casing department.

The terminal end of the large intestine is next removed from the abdominal viscera and is flushed free of its contents. This portion of the intestine is called the bung or bung gut and is taken to the casing department immediately after being flushed.

The cecum along with the remaining large intestine completes the digestive tract and this is also removed from the mesenteric fat. This intestine is flushed by placing it over long perforated stand pipes. A strong flow of water passes out of the end of this pipe and through its perforations to flush out the intestinal contents. This portion of the intestine is known as the chitterling and is handled as an edible product after being thoroughly cleaned both inside and outside.

The separation of the intestines from the mesenteric fat is so conducted as not to contaminate the fat with any of the intestinal contents. This fat is handled in a clean manner throughout and is used in the rendering of lard. The pancreas is sometimes removed from the mesenteric fat and saved for pharmaceutical purposes.

Sheep.—Because of their thick, heavy, wool covering, it is important to keep sheep and lambs free from mud and contamination before they are slaughtered. It is extremely difficult to avoid contaminationof sheep and lamb carcasses during the dressing operations when the pelt is soiled.

It is not the practice in the United States to stun sheep, lambs, or goats. They are driven into a shackling pen where each is shackled above the foot on the right hind leg and hoisted to the bleeding rail. Except when the kosher method is used, bleeding is accomplished by inserting a sharp, pointed knife into the neck just below the ear and severing the blood vessels in that region. In the kosher method a sharp knife is drawn transversely across the neck just behind the angles of the mandible. Generally, sheep and lambs are skinned in connection with the dressing operation since it is very difficult to wash the pelt sufficiently clean to justify its remaining on the dressed carcass.

After the animal is bled, it moves on the rail still shackled by the right hind leg to the position where the free left hind leg isskinned. The foot is removed. The knife is inserted under the tendons on the posterior side of the metatarsal bones toward their distal end. The carcass is then transferred from the shackle rail to the dressing rail by a hook inserted through this opening. The right leg is then released from the shackle and it also is skinned. It is attached to a hook in the same manner as the other leg, leaving the carcass suspended entirely from the dressing rail.

Care is exercised in the skinning of the hind legs to avoid soiling the skinned portions of the carcass by contact with the wooly portion of the pelt. It is the practice in some meat packing plants to cover the skinned

portions of the hind legs with a protective sheet of parchment paper immediately after the pelt is removed.

The carcass is now hoisted by the feet of its forelegs to another rail which suspends the body nearly parallel with the floor. In this position the plant employee skins out the neck, shoulders, and the sides of the head. He also raises the esophagus and loosens it from its attachments as it passes through the thorax, ligating the cervical end at the same time. This facilitates removal of the esophagus along with the abdominal viscera when the carcass is later eviscerated. It also avoids probable contamination of edible portions of the carcass by such paunch contents as might gravitate down the esophagus with the carcass hanging in the inverted position. The trachea is also loosened to facilitate evisceration.

The forelegs are now released and the carcass is left suspended from the dressing rail by its hind legs. The rectum is loosened; however, it is not necessary that it be ligated inasmuch as the nature of its contents is such as to present no threat of contamination. The carcass is then completely skinned. The removal of the skin from the head presents the only real problem from the point of view of sanitation inasmuch as considerable care must be exercised in order to remove completely all of the skin from the face.

The carcass is prepared for evisceration by opening it along the median line. Here again it is necessary that care be exercised to avoid puncturing any of the abdominal viscera. The bladder, uterus, and penis are removed at this time.

Just before evisceration the duodenum is ligated at two points approximately 3 inches apart where it leaves the abomasum. The duodenum is severed between these ligations at the time of evisceration.

The lungs, heart, and liver are presented for inspection separate from the digestive tract portion of the abdominal viscera. This is presented together but separated into the stomach portion which is ligated both at the esophagus and the duodenum and the intestinal portion which is ligated at the duodenum.

The inspection consists of palpating the lungs and their accompanying lymph glands, the heart, and the liver. The bile duct is cut transversely to permit examination for possible fluke infestation. The abdominal viscera are observed for any abnormal condition.

The rail inspector observes the carcass as it is hanging from the rail, head attached. He palpates the prescapular, prefemoral, and superficial inguinal (supramammary lymph glands). Using both hands, he then opens up the interior of the carcass to view, examining the surfaces of the peritoneum and pleura. He also examines the pelvic cavity to detect any contamination or portions of the genitalia which may have been left attached during the dressing operation. He looks at the head, particularly, to make sure that all of the skin and the horns have been removed.

When a condition is found which requires more detailed examination of the carcass, the organs or lymph glands related to the condition are examined further by repeated incisions and palpation. Carcasses and their viscera which require final inspection are taken to the space set apart for that purpose.

When the carcass passes the inspection it moves along the rail to the position where it is given a thorough washing. The head is removed. Each head is handled individually by first flushing out contents of the nasal and oral cavities. Many heads are shipped to the trade as whole heads after chilling. Others are processed by removing the tongue, the cheek meat, and the brain. The tonsils are removed from each tongue which is washed individually before being placed on a tray for chilling. The brains are examined for detection of parasitic infestation.

FIG. 8.—Rail inspection of a lamb carcass.

The lungs, heart, liver, and spleen are classed as edible; the lungs and heart usually being sold intact. The omental fat (caul fat) is saved for rendering into edible fat.

The small intestines are pulled from the mesenteric fat. They are stripped of their contents and passed through sliming machines which crush and squeeze the mucous lining from their lumen. These intestines then go to the casing department. The mesenteric fat is kept clean and free from contamination and is saved for rendering into edible fat.

Pathology. Under this heading consideration is given to abnormal conditions affecting carcasses, their organs, and parts of carcasses, which have meat hygiene significance. Only a brief mention is made of the etiology and pathogenesis of each condition, since they are fully covered in courses and texts on veterinary bacteriology, pathology, and parasitology. The consideration given to lesions and their post-mortem significance is calculated to give only that emphasis which is necessary to relate the condition found on post-mortem inspection to the disposition of the affected carcass, organ, or part of carcass as to its fitness for human food.

Tuberculosis. This is a chronic, infectious disease affecting man, animals, and poultry, showing occasional acute manifestations. In the United States, the program of eradication of tuberculosis from cattle has progressed successfully to that point where eradication is considered to be practically accomplished. The success of this program is dramatically illustrated by comparing the number of retentions and condemnations of cattle for tuberculosis under Federal meat inspection during the year 1920 with the year 1948 (Fig. 9). The eradication of tuberculosis from cattle has not resulted in a comparable lowering of the incidence of tuberculosis in swine. The higher percentage of swine affected with tuberculosis is explained by the transmissibility of avian tuberculosis to swine. There is a high incidence of tuberculosis in poultry in the United States.

Item		*Cattle No.*	*%*	*Swine No.*	*%*
Animals slaughtered in	1920	9,709,819		38,981,914	
	1948	14,250,362		48,551,552	
Animals retained for tuberculosis in	1920	200,647	2 05	4,360,719	11 16
	1948	15,422	0 18	2,968,631	6 11
Animals condemned for tuberculosis in	1920	37,492	386	65,607	.168
	1948	1,464	010	9,761	.020

Fig. 9. Retentions and condemnations of cattle and hogs under Federal Meat Inspection, years 1920 and 1948.

Lesions of coccidioidal granuloma (see page 64) in cattle resemble lesions of tuberculosis. Hypothetically, histoplasmosis might be confused with tuberculosis, however, this condition has not so far been identified in meat inspection post-mortem examinations.

Etiology and Pathogenesis. *Mycobacterium tuberculosis*, bovine type, causes tuberculosis in cattle. *Mycobacterium avium* is the cause of tuberculosis in poultry. Both of these organisms are pathogenic for swine. Sheep are moderately susceptible to both organisms. The organism enters the body through the respiratory and digestive tracts. In cattle, the respiratory tract and the pleura are most generally affected. However, involvement of the lymph glands of the digestive tract, the peritoneum, and the liver is quite common. The cervical, bronchial, and mediastinal lymph glands are the most common sites of infection in cattle. In addition, lesions of tuberculosis may occur in any of the organs and the visceral and body lymph glands.

In swine, the lesions most commonly occur in the cervical, bronchial, mediastinal, and mesenteric lymph glands. The involvement of the liver, spleen, and mesenteric lymph glands is more common in swine than in cattle. However, pulmonary involvement is quite common in swine. Lesions may occur also in any of the organs, the viscera, and the body lymph glands.

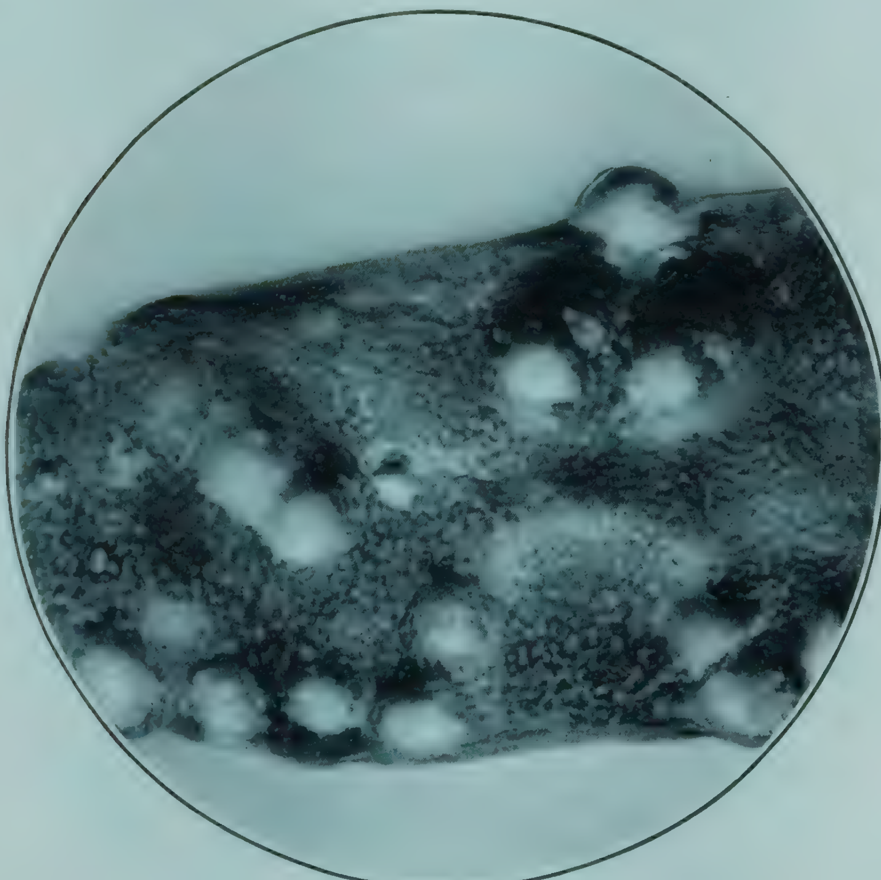

FIG. 10.—Lesions of tuberculosis in a hog spleen.

In sheep, the lesions are generally confined to the lymph glands of the respiratory tract and the lungs. In poultry, the disease is seen most frequently in the liver, spleen, intestines, and bone marrow. The infection in the majority of instances in poultry occurs by way of the digestive tract, resulting in a greater incidence of involvement in the organs of that tract rather than the lungs.

Lesions.—The tubercle is the characteristic lesion of tuberculosis. In the early stages, it is a gray, transparent nodule just large enough to be seen by the unaided eye. As the lesion develops, caseous degeneration commences in the center which gives the tubercle a yellowish cast. Tubercles fuse to form nodules of increasing size. The nodules combine to form a large, yellow caseous mass which tends to calcify. The size of these masses varies considerably. The center of such a mass varies in consistency from caseo-purulent to caseous and caseo-calcareous. Histologically, lesions generally show central areas of caseation necrosis con-

taining points of calcification surrounded by a zone of lymphocytes, epithelioid cells, fibroblasts and giant cells. Acid-fast Mycobacterium organisms are found in the lesions.

Post-Mortem Significance.—Tissue affected with tuberculosis or contaminated by the products of a tuberculous process is unfit for food. An organ is unfit for food when it contains a lesion of tuberculosis or a lesion of tuberculosis occurs in a lymph gland draining the organ. The head of the carcass is unfit for food when a well-marked lesion of tuberculosis occurs in a cervical lymph gland draining the head. A carcass, any part

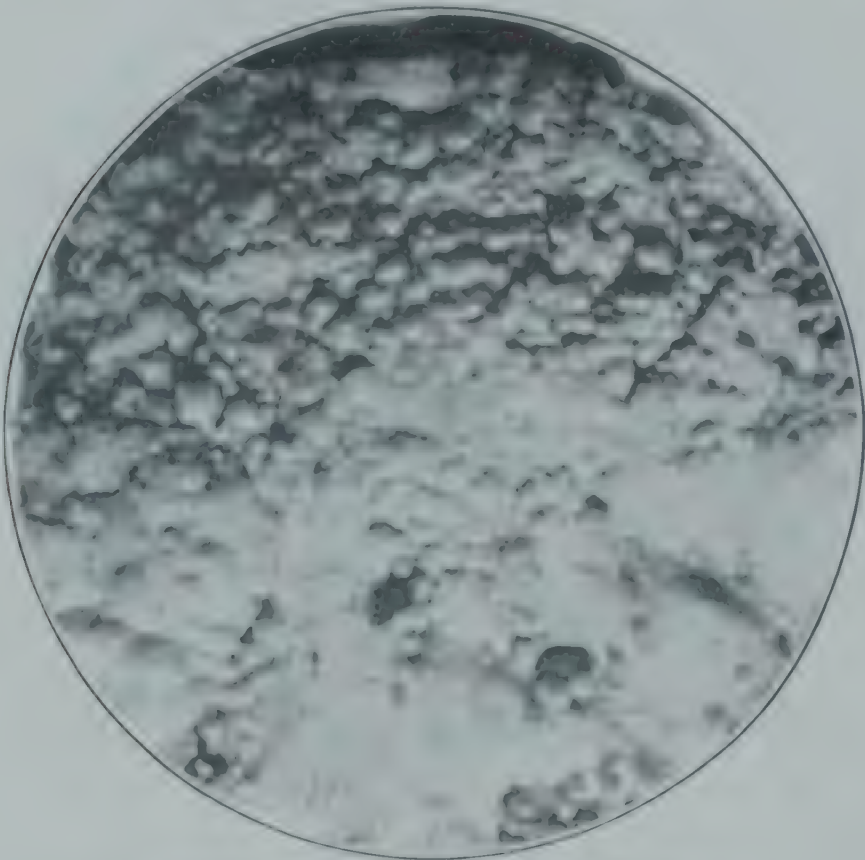

FIG. 11.—Lesions of tuberculosis affecting the peritoneum of a cow.

thereof, and all of its viscera are condemned when an extensive involvement of tuberculosis occurs in either body cavity or when affected with the acute or miliary form of the disease. Sections 11.2 and 11.3 of the Federal Meat Inspection Regulations on Pages 359 to 361 of the Appendix give in detail guides for use in making dispositions of carcasses affected with tuberculosis.

Actinomycosis.—This is an infection of the mandible and maxilla occasionally encountered during the inspection of the head and cervical region of cattle. The condition is commonly referred to as "lumpy jaw."

Etiology and Pathogenesis.—The "ray fungus," *Actinomyces bovis* is the causative agent. The organism is thought to enter through the mucous membrane by way of injuries to the mucosa caused by rough forage.

Lesions in the tongue, the soft tissues of the head, and in the viscera were once thought to be caused by this organism. These lesions are now considered to be caused by the *Actinobacillus lignieresi*. Lesions resembling actinomycosis in the udder are also attributed to the actinobacillus.

Lesions. The lesions are limited to the bony structure of the head and are characterized by the formation of soft granulomatous tissue. Necrotic areas form which develop into abscesses. The abscesses break down to form sinuses or fistulus tracts. A characteristic pus is formed which is thick, tenacious, and greenish-yellow.

FIG. 12.—Actinomycosis affecting a bovine mandible (cross section).

Post-Mortem Significance.—In those heads in which the enlargement is moderate and there is no discharge of pus from the process, the tongue is removed and passed for food while the head is unfit for food. In those cases where the involvement is large and pus is discharging from the process, the entire head including the tongue is unfit for food.

Actinobacillosis.—This condition is the one generally found involving the tongue and is known as "wooden tongue."

Etiology and Pathogenesis.—The organism *Actinobacillus lignieresi* is the infective agent. It is believed to pass into the body through injuries of the mucosa, being then picked up by the lymphatics. The usual sites of infection are the tongue and cervical lymph glands, and lesions also occur under the skin in the cervical region. Occasionally, the infection involves the bronchial and mediastinal lymph glands and the lungs. Lesions also occur in the udder; the infection is believed to gain entrance through the teats from the mouth of the suckling offspring.

Lesions.—At the site of infection a tumorous mass slowly develops. Later, softening of the interior of the mass occurs with the formation of a thick, mucoid pus. Lesions of actinobacillosis are frequently mistaken for actinomycosis. The distinguishing characteristic, however, is the fact

that the actinomyces usually attacks the bone while the actinobacillus invades the soft tissues.

Post-Mortem Significance. When the disease is slight and limited to the lymph glands of the head, the head including the tongue is fit for food after removal of the affected glands. The head including the tongue is unfit for food where there is a more extensive involvement than the foregoing. When the involvement of the viscera or the udder is slight and localized, the carcass is fit for food provided the affected organs are disposed of as unfit for food. There is rarely an extensive involvement of the lung in which case the entire carcass is unfit for food.

FIG. 13.—Actinobacillosis affecting a bovine tongue (cross section).

Cysticercosis.—*Cysticercosis in Cattle.*—This is the condition known as "beef measles" commonly occurring in cattle but only occasionally in calves.

Etiology and Pathogenesis.—The bladder worm, cysticercus bovis, is the cystic form of the adult tapeworm, *Tænia saginata*, occurring in man. The cyst is found chiefly in the muscles of the jaw, heart, and diaphragm, and also in the musculature in many other parts of the body. In some cases the wall of the esophagus is the preferred location.

Lesions.—The full-grown bladder worm measures about 7½ by 5½ mm. situated in the intra-muscular connective tissue surrounded by a thin connective tissue capsule. The cysticerci may die a short time after development and become calcified.

Post-Mortem Significance.—A carcass in which only one dead and degenerated cyst is found on inspection is passed for food without restriction after removal of the cyst. A carcass showing a slight or moderate infection as determined by a careful examination of the heart, muscles of mastication, the diaphragm and its pillars, the tongue, and all of the portions of the carcass rendered visible by the process of dressing, is passed for food after removal of the cysts and after the carcass and all

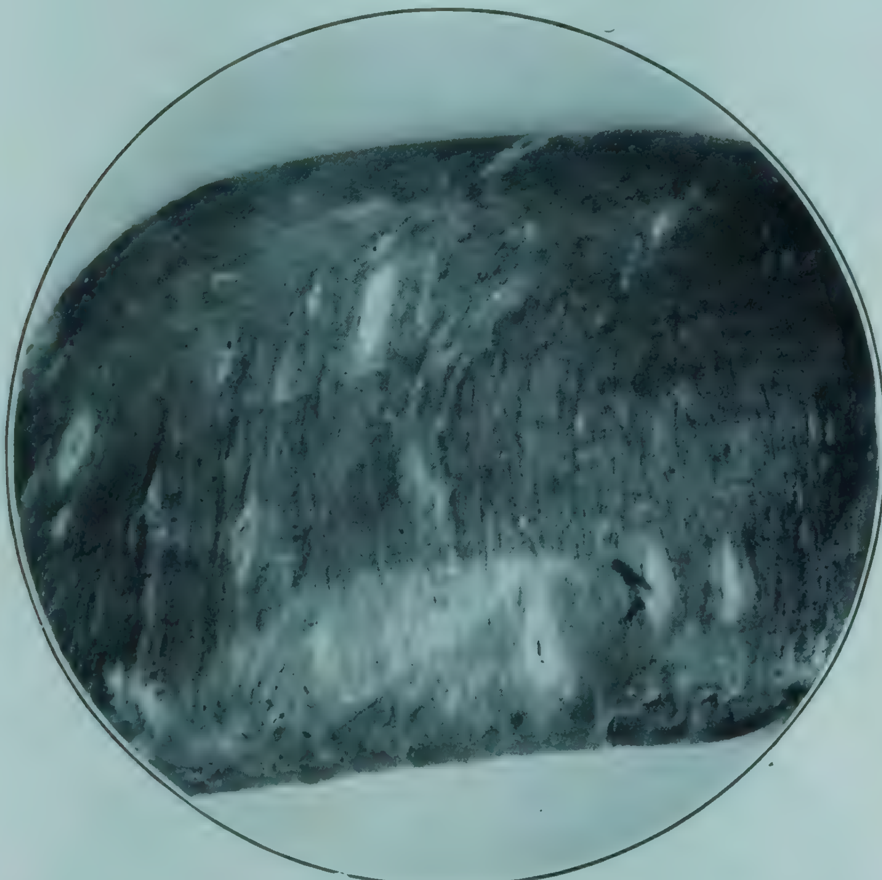

Fig. 14.—Section of muscle of bovine heart showing degenerated cysts of *Cysticercus bovis.*

of its parts have been held in a temperature of not higher than 15°F. continuously for a period of not less than ten days. A carcass showing an extensive infestation is unfit for food.

Cysticercosis in Swine. This is the condition known as "pork measles."

Etiology and Pathogenesis.—The bladder worm known as *Cysticercus cellulosa*, the cystic form of *Tænia solium* occurring in man, produces this condition. The cysts are found chiefly in the muscles of the heart, tongue, thigh, and neck. They may also invade the fat and other tissues. The carcass affected with this condition when opened at the neck for cervical inspection will often show the cysts distributed in the tissue under the tongue like a bunch of grapes.

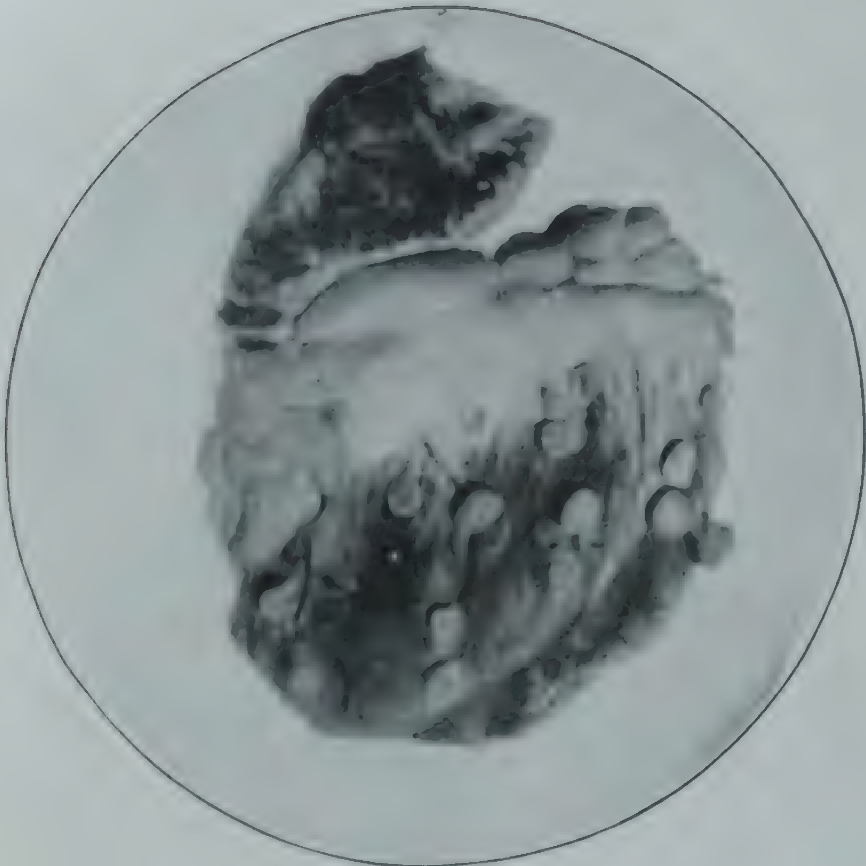

Fig. 15.—Cysticercus cellulosæ in a hog heart.

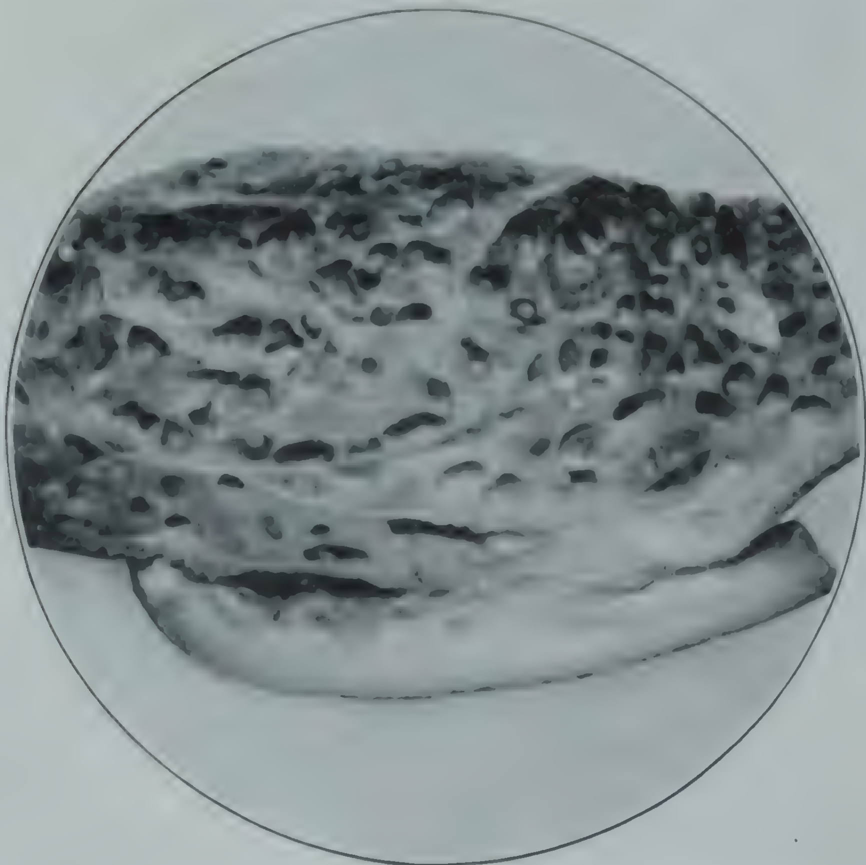

Fig. 16.—Section of hog muscle showing cysticercus cellulosæ infestation.

Lesions.—The fully developed cyst measures up to 20 by 10 mm. and contains an invaginated scolex which resembles that of the adult worm. Although the larvæ continue alive for a long time, degenerated cysts are seen in which the scolex is all that remains.

Post-Mortem Significance.—A carcass affected with this condition is unfit for food.

CYSTICERCOSIS IN SHEEP.—(*A*) CYSTICERUS OVIS.—This condition in sheep is similar to the cysticercosis which occurs in cattle. Although the involvement is comparable to the condition known as cattle measles and hog measles, the term "sheep measles" has not come into general use.

Etiology and Pathogenesis.—The causative agent is the *Cysticercus ovis* which is the cystic form of *Tænia ovis* occurring in the small intestine of the dog. The cysts are usually seen in the heart, diaphragm, and the tongue. Although the cysts are reported as occurring in other tissues they are usually observed confined to the musculature.

Lesions.—The cyst resembles *Cysticercus bovis* in size and consistency. Usually the larvæ die after a short time and the lesions become organized with a degree of calcification.

Post-Mortem Significance.—Carcasses so affected that complete removal of the cysts cannot be accomplished with certainty are not fit for food. Where the infestation is slight and all of the cysts can be removed, the carcass is passed for food.

(*B*) CYSTICERCUS TENUICOLLIS.—This condition in sheep is distinguished from other cysticercus involvement in that the cysts occur pendulous in the peritoneal cavity. It does not infest the musculature.

Etiology and Pathogenesis.—The cyst is caused by the *Cysticercus tenuicollis*, the cystic form of the *Tænia hydatigena* which occurs in the dog and other carnivora. The cysticerci break down the liver parenchyma during their migration, causing hemorrhages and leaving behind them a tract of detritus. The cysts are seen hanging free in the peritoneal cavity attached to the peritoneum. Foci of bronchopneumonia and pleuritis have been described as being caused by young cysticerci which enter the lungs.

Post-Mortem Significance.—Generally, the condition is found to be limited to the presence of cysts in the peritoneal cavity. In such cases the cysts can be readily removed and the carcass is then fit for food. Should the involvement be such as to affect the general condition of the carcass, it is unfit for food.

"Gid" in Sheep.—This condition is caused by parasitic invasion of the brain and spinal cord generally observed in meat inspection only in sheep but reported to occur also in other domesticated animals and in man.

Etiology and Pathogenesis.—The causative agent is the *Multiceps multiceps* (*Cœnurus cerebralis*) which is the intermediate stage of the *Tænia multiceps* which occurs in the small intestine of the dog. Usually the cyst is situated on the surface of one of the cerebral hemispheres. Cysts do occur, however, in any part of the brain. Occasionally, the cyst is located in the spinal cord. The condition usually seen in post-mortem meat inspection is the brain involvement.

Lesions.—The full-grown cyst measures 5 cm. or more in diameter.

It has a delicate, translucent wall and bears on its inner surface a number of heads which may amount to several hundred, each resembling the scolex of the adult worm.

Post-Mortem Significance.—This condition is not frequently seen in meat inspection since animals having any degree of involvement would not reach the slaughtering department. The condition seen on post-mortem consists of a slight involvement of the brain with the carcass showing no systemic change. In such cases the brain is unfit for food while the carcass is passed for food. Should the carcass show any systemic involvement as a result of the cystic condition, it is unfit for food.

Stomach Worm in Sheep. This condition is also known as "wire worm" and affects all ruminants. The sheep involvement is the only one of significance in meat inspection.

Etiology and Pathogenesis.—The condition is caused by the nematode *Hæmonchus contortus*, the male measuring 10 to 20 mm. long, the female 18 to 30 mm. The male has an even reddish color while in the female the white ovaries are slightly wound around the red intestine. Upon entering the host, the young worms burrow into the mucosa of the abomasum. The adult worms live free in the abomasum and attack the mucosa which they pierce with their buccal lancets to suck blood. It appears likely that an anti-coagulant is inserted into the wound by the parasite. The mucosa becomes very irritated and the worms deprive the host of a large quantity of blood. It is probable that a large amount of blood also passes through the body of the parasite.

Lesions.—The irritation of the abomasum is secondary in importance to the loss of blood. Anemia develops with a degree of rapidity depending on the extent of the infestation. In lambs or young sheep with severe infestation, anemia develops rapidly.

Post-Mortem Significance.—Animals in which the condition has not developed to the point where ante-mortem symptoms are noticed are passed on post-mortem inspection as being fit for food. The abomasum is not an article of human food in any case and is handled as inedible. Carcasses from animals which have been suspected on ante-mortem inspection of being affected with a condition which might cause their condemnation on post-mortem inspection are unfit for food when affected with anemia resulting from infestation by this parasite.

"Ox Warbles". This condition is a common parasite of cattle and calves and is widespread in the United States.

Etiology and Pathogenesis.—The condition is caused by the larvæ of the heel flies, *Hypoderma lineatum* and *Hypoderma bovis*. The larvæ hatch from the eggs which are laid on the hair of the skin and crawl down the hair to the skin through which they penetrate. They wander in the subcutaneous connective tissue gradually finding their way to the esophageal wall where they lie in the submucous connective tissue for the rest of the summer and autumn growing to about 12 mm. in length. In the latter part of the winter the larvæ migrate to the subcutaneous tissue of the back. Here they increase in size to about 3 cm.

Lesions.—The nodules caused by the larvæ in the subcutaneous tissue of the esophagus usually contain small amounts of pus. At the sites of

the larvæ in the subcutaneous tissue of the back a definite localized swelling occurs surrounded by some edema. Along with the larva the swelling includes considerable pus and takes on the appearance of a small abscess.

Post-Mortem Significance.—The mucous lining of the esophagus is one of the animal casings and the presence of the larvæ makes the casing unfit for use as a container of human food. The involvement of the subcutaneous tissue of the back by the larvæ is generally localized. Complete removal of the tissue involved with the parasitic process is usually sufficient to permit passing the carcass for food. The back of older calves dressed with the skin on is palpated to detect swellings caused by the parasite. When present, the skin is required to be removed from the carcass and the affected tissue removed by trimming.

Kidney Worm of Swine.—This parasite is widely distributed in the Southern part of the United States and in the East Central States and is of considerable economic importance because of the large amount of tissue which is required to be trimmed away from swine carcasses due to the infestation.

Etiology and Pathogenesis.—The condition is caused by the round worm *Stephanurus dentatus.* The male is 20 to 30 mm. long, the female 30 to 45 mm. long. The development of the parasite in the host is somewhat complicated. Suffice it to say the migration of the larvæ causes damage to the liver. The principal involvement, however, affects the sublumbar region where the parasites invade the perirenal tissues. They penetrate into the organs of that region, and the psoas muscles, fanning out to involve all tissues in their path depending upon the degree of infestation.

Lesions.—The sublumbar region of all swine carcasses must be examined carefully to detect the probable presence of this parasite. In light infestations, there are few evidences of the parasite's presence. Slight edema frequently occurs and the perirenal fat shows a slight hyperemia as evidence of the parasite. It is necessary sometimes to cut into the tissue to reveal the lesions. Where the infestation is extensive the tissue changes are more marked, there being extensive edema and some hemorrhage.

Post-Mortem Significance.—Carcasses affected with this condition when extensive and accompanied with systemic manifestations are unfit for food. Carcasses are passed for food when the infestation is slight and complete removal of the parasites and involved tissue can be accomplished.

"Nodular Disease" in Sheep.—This condition which is limited to sheep and goats is of significance principally because it destroys a large number of intestines for use as animal casings.

Etiology and Pathogenesis.—The condition is caused by the larval form of the round worm *Oesophagostomum columbianum.* The larvæ pierce the wall of the intestine in which they grow to a length of about 1.5 to 2.5 mm.

Lesions.—The reaction of the tissue of the wall of the intestine to the presence of the larvæ forms the characteristic nodules which vary in size up to 5 mm. The contents of these nodules caseate and calcify. There is usually an opening from the nodule into the intestine.

Post-Mortem Significance.—The condition as it is usually seen in meat inspection does not affect the disposition of the carcass even though the

intestines are involved to a considerable extent by the parasite. The carcass is passed for food after elimination of the affected intestines provided there is no systemic involvement. Where the parasitic condition is such as to produce peritonitis associated with systemic manifestations, the carcass is unfit for food.

Hydatid Disease. This condition affects man as well as domesticated mammals. There has been a gradual decrease in the occurrence of this condition in the United States. It is only rarely seen during the conduct of meat inspection post-mortem examinations.

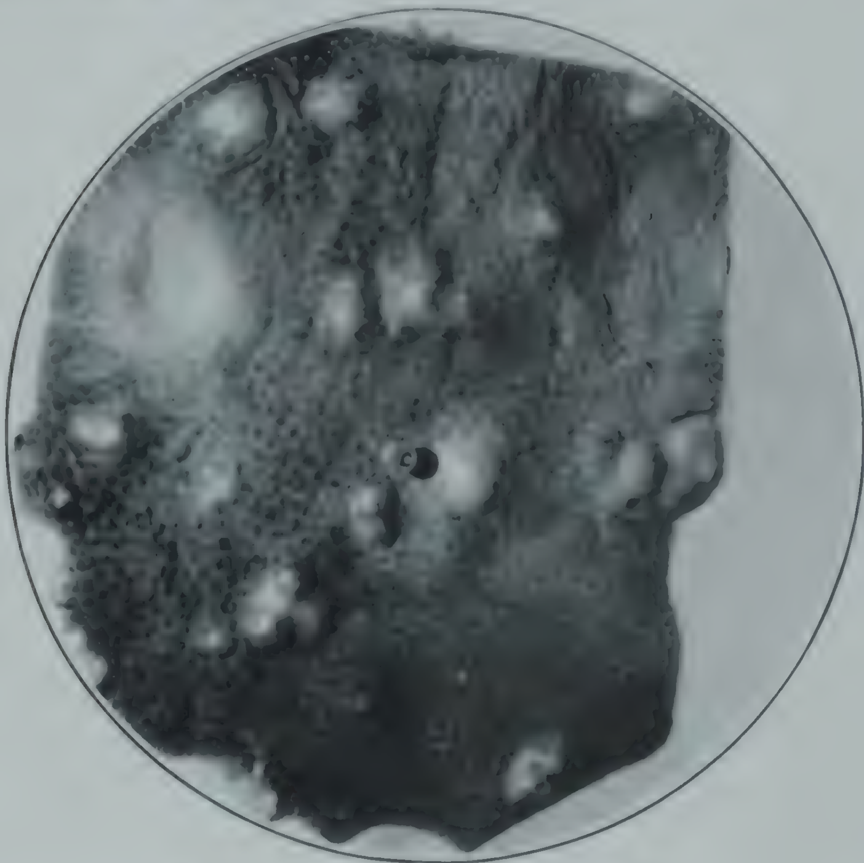

Fig. 17.—Echinococcus cysts in a hog liver

Etiology and Pathogenesis. The condition is caused by the embryonic stage of the tapeworm *Echinococcus granulosus* which is found in the small intestine of carnivora. The eggs are ingested by the intermediate host, hatching in the intestine. The embryos then migrate through the bloodstream to the various organs of the host. They usually locate in the liver and lungs.

Lesions. The embryo forms in a large vesicle 5 to 10 cm. in diameter. A thick cuticle forms around the vesicle concentrically laminated with an internal germinal layer. The vesicle is filled with a clear, colorless fluid. Daughter cysts are sometimes formed.

Post-Mortem Significance. Affected organs are unfit for food.

Pentastoma. This condition affects herbivorous animals. It is most commonly seen in cattle on meat inspection post-mortem examinations.

Etiology and Pathogenesis.—The condition is caused by the nymphal stage of the *Linguatula serrata*, the "Tongue-worm" which occurs in the nasal and respiratory tract of carnivora principally. The eggs which are expelled from the respiratory tract of the host hatch in the alimentary canal of the intermediate herbivorous host. The larvæ reach the mesenteric lymph glands where they develop into the infective nymphal stage. The nymph is 5 to 6 mm. long and has a white color.

Lesions. The nympha are present in the mesenteric lymph glands in small cysts surrounded by a viscid turbid fluid. The presence of the cysts results in an enlargement of the affected lymph glands and gives them a juicy consistency. In older lesions there is a tendency towards caseation producing a lesion which is sometimes confused with tuberculosis.

Post-Mortem Significance.—The condition is localized in the mesenteric lymph glands. Accordingly, the carcass is passed for food after the mesenteric fat with the imbedded lymph glands is disposed of as being unfit for food.

Onchocerca Gibsoni. The condition caused by this round worm was once thought to occur only in cattle imported into this country from Australia. In recent years the condition has been reported in connection with meat inspection post-mortem examinations made in the United States.

Etiology and Pathogenesis.—The male *Onchocerca gibsoni* is 30 to 53 mm. long and the female has been reported as measuring 500 mm. or more. The vector of this parasite is not definitely known. The parasite first wanders about in the connective tissue before coming to rest usually in the region of the brisket and the external surfaces of the hind limbs.

Lesions.—At these locations they form "worm nests" which are surrounded by a fibrous connective tissue capsule which increases in size as the lesion grows older. The whole nodule may be 5 cm. in diameter. It is ovoid or flattened in shape. The worm nest consists of tunnels containing the coiled worm. In older nodules degeneration of the tissues and calcification of the worms frequently occurs.

Post-Mortem Significance.—The condition is localized and the carcass is passed for food after the affected tissue is removed.

Ascariasis.—The worms causing this condition in man and in swine are morphologically indistinguishable. It is a common round worm infection of swine associated with unclean housing conditions.

Etiology and Pathogenesis.—The condition is caused by the *Ascaris lumbricoides*, the male measuring 15 to 25 cm. by about 3 mm., and the female up to 41 cm. by 5 mm. The ingested eggs hatch in the intestine and the larvæ burrow into its wall. The larvæ pass through into the peritoneal cavity reaching the liver either by migration direct or through the bloodstream. From here they are carried by the blood to the lungs where they are arrested in the capillaries.

Lesions.—The larvæ cause much damage in the liver and lungs during their migration. They produce hemorrhage and destroy tissue in the liver. In the lungs, they cause numerous hemorrhages into the alveoli and bronchioles. Secondary bacterial invasion of the lung lesions sometimes results in pneumonia. The adult parasite in the intestines does considerable damage to the walls of the intestines, however, the principal damage here

is caused by their wandering up the bile duct into the liver. This occasionally produces icterus in the carcass due to the stoppage of the bile duct.

Post-Mortem Significance.—Carcasses showing icterus as a result of the infestation are unfit for food. Carcasses showing systemic manifestations in connection with inflammatory lung processes caused by the infestation are unfit for food. Localized conditions in the lungs are of little significance inasmuch as the lungs of swine are always handled as inedible. Livers affected by the infestation are fit for food only if the damage is so slight as to permit removal of the damaged tissue from the unaffected portion of the liver.

Liver Flukes.—DICROCOELIUM DENDRITICUM. This is the smallest of the three liver flukes affecting domesticated animals. It is most commonly seen in cattle and sheep and occasionally in swine.

Etiology and Pathogenesis.—This fluke is from 6 to 10 mm. long and from 1.5 to 2.5 mm. wide. The body is elongated, narrow anteriorly and widest behind the middle. These small flukes invade the small branches of the bile ducts in which they lie greatly extended and attached by their suckers. Occasionally they occur along with the *Fasciola hepatica* (*infra*).

Lesions.—No marked change is produced in the liver unless the infestation is heavy. Cirrhosis of the liver occurs in heavy infestation as well as other indurative changes of the liver tissue.

Post-Mortem Significance.—Affected livers are unfit for food regardless of the degree of infestation.

FASCIOLA HEPATICA.—This fluke usually infests ruminants, rarely affecting swine and man. It causes the condition usually referred to as "liver rot" in sheep and cattle.

Etiology and Pathogenesis.—The fluke reaches 30 by 13 mm. in size, is leaf-shaped, and is broader anteriorly than posteriorly. It has an anterior cone-shaped projection which is followed posteriorly by a pair of "broad shoulders." The young fluke burrows into the intestinal wall reaching the liver generally by way of the blood stream. Others migrate through the peritoneal cavity entering the liver by penetrating its capsule. They attach themselves to the peritoneum occasionally along the way to suck blood. After entering the liver they grow and wander in the liver tissue eventually reaching the bile ducts.

Lesions.—No significant damage is done in the peritoneal cavity. The young flukes destroy the liver tissue as they wander through it, the destruction increasing as the parasite grows. The adult flukes in the bile duct cause considerable irritation of the mucosa resulting in chronic cholangitis and cirrhosis which extends into the liver tissue. Icterus sometimes occurs in the carcass due to stasis of bile as the result of large flukes blocking the ducts.

Post-Mortem Significance.—Carcasses affected with icterus due to fluke infestation are unfit for food. Affected livers, regardless of degree of infestation, are unfit for food.

FASCIOLOIDES MAGNA.—This is the largest of the flukes infesting the livers of cattle and sheep. It is reported to occur rarely in the lungs. This parasite is not encountered in meat inspection post-mortems as frequently as the other two flukes.

Etiology and Pathogenesis.—The fluke is quite large, measuring up to 100 by 25 mm. A characteristic that assists in distinguishing this fluke from *Fasciola hepatica* is the absence of an anterior cone-like projection which is present on the smaller parasite. The parasite wanders about in the liver tissue becoming encapsulated eventually. Their pathogenicity in cattle is reported as being relatively low since the young parasites become encapsulated before reaching maturity. In sheep the parasite reaches maturity unchecked doing great damage in the liver.

Lesions.—Due to the amount of damage done to the liver tissue and the tendency toward encapsulation of the parasite, infested livers present an uneven surface appearance. There is also a characteristic black pigmentation of the liver and the hepatic glands extending sometimes to the adjacent peritoneum.

Post-Mortem Significance.—Affected livers are unfit for food regardless of the extent of the infestation.

Mange.—SARCOPTIC.—This condition commonly affects all domesticated animals.

Etiology and Pathogenesis.—The sarcoptes mange mite is a very small parasite roughly circular in outline. It prefers those parts of the body that are not covered by much hair or wool. The parasite pierces the skin to feed on the lymph and young epithelial cells.

Lesions.—The irritation and inflammation of the skin results in an exudate which forms a crust over the surface. As the condition progresses there is extensive keratinization and proliferation of the subcutis. This is usually accompanied with the loss of hair.

Post-Mortem Significance.—Where the condition is associated with emaciation in the animal, the carcass is unfit for food. Generally, the condition is limited to the skin and has no noticeable effect on the well-being of the host. In sheep and cattle where the hide is removed as part of the dressing operation, the condition has no post-mortem significance when localized in the skin. All affected hides are removed from calves after which the carcass is passed for food. Affected portions of the skin are removed from hog carcasses which are then passed for food.

PSOROPTIC.—This type of mange does not affect swine but is found in sheep and cattle. However, by contrast with sarcoptic mange, this condition is caused by a number of different parasites, each specific for different species of host.

Etiology and Pathogenesis.—The condition in sheep is caused by the *Psoroptes communis ovis* and in cattle by the *Psoroptes communis bovis.* The mites are oval in shape. They prefer those parts of the body that are well-covered with hair or wool. They puncture the epidermis to feed on the lymph, thereby setting up an inflammation characterized by a swelling infiltrated with serum. This results in an exudation on the surface of the affected part which coagulates to form a crust. The mites are particularly active along the borders of the affected area thereby extending the process.

Lesions.—The lesions occur principally around the shoulders, sides, and back. These areas become matted to form the characteristic scab.

Post-Mortem Significance.—In those cases where emaciation or systemic

involvement accompany the mange, the carcass is unfit for food. Otherwise the carcass is passed for food.

Demodectic.—This is the third type of mange and affects all domesticated animals. It is frequently referred to as follicular mange. It is not as common as the other two.

Etiology and Pathogenesis.—The demodex mange mites are very tiny. They are elongated by contrast with the sarcoptes mange mite which is circular in outline and the oval psoroptes. The parasite is approximately 0.25 mm. long. The mites develop in the skin of the host entering the hair follicles and sebaceous glands.

Lesions.—The chronic inflammation produced by the parasite causes proliferation and thickening of the epidermis with the loss of hair. Pustules and abscesses frequently form in the hair follicles and sebaceous glands due to a secondary bacterial invasion. The formation of pustules and abscesses associated with demodectic mange helps to distinguish it from the other forms of mange.

Post-Mortem Significance.—The carcass is unfit for food when the infestation has progressed to the point where the carcass shows evidence of toxemia or emaciation. Generally, the condition has not progressed so far as to affect the carcass, in which case it is passed for food after removal of the diseased tissue.

Lung Worms.—Cattle.—This condition is usually seen in young animals only.

Etiology and Pathogenesis.—The *Dictyocaulus viviparus* is the cause of the condition. The male measures 4½ to 5 cm. long, the female 6 to 8 cm. long. They infest the bronchi.

Lesions.—In the young animal the presence of the parasites in the bronchi sets up varying degrees of inflammation in the lungs. In advanced cases emaciation and anemia are observed.

Post-Mortem Significance.—The carcass is fit for food when the infestation is slight and there is no secondary change, provided the lungs are eliminated as unfit for food. In those cases where there is pneumonia accompanied with systemic manifestations or when there is emaciation or anemia the carcass is unfit for food.

Swine.—There are three round worms which commonly infest the lungs in swine.

Etiology and Pathogenesis.—They are *Metastrongylus apri*, male up to 25 mm. long, female up to 58 mm. long; *Metastrongylus pudendotectus*, male up to 18 mm. long, female up to 37 mm. long; and *Metastrongylus salmi*. They infest the bronchi and bronchioles.

Lesions.—The parasites set up varying degrees of inflammation in the lungs producing a verminous bronchitis and sometimes pneumonia. The parasites sometimes die in the small bronchioles with resulting nodule formation. These nodules may be confused with tuberculous nodules in meat inspection post-mortem examination.

Post-Mortem Significance.—Generally, the condition is localized in the lungs in which case the carcass is passed for food; hog lungs in any case are handled as inedible. Where there is extensive inflammation of the lung associated with systemic change, the carcass is unfit for food.

SHEEP.—There are also three lung worms affecting sheep. Two of them are found in the bronchi and bronchioles while the third invades the parenchyma of the lungs.

Etiology and Pathogenesis.—The *Muellerius capillaris*, male 12 to 14 mm. long, female 19 to 20 mm. long, invades the alveoli and the pulmonary parenchyma especially in the subpleural tissue. *Protostrongylus rufescens*, male 16 to 18 mm. long, female 25 to 35 mm. long, and *Dictyocaulus filaria*, male 3 to 8 cm. long, female 5 to 10 cm. long, invade the bronchi and bronchioles where they suck blood and irritate the mucosa.

Lesions.—The parasite which invades the lung tissue produces grayish nodules up to 2 cm. in diameter which tend to calcify. Those parasites which infest the bronchi and bronchioles set up inflammation varying in degrees and sometimes produce pneumonia.

Post-Mortem Significance.—All affected lungs are unfit for food and if the condition is localized in the lungs, the carcass is passed for food. The carcass is unfit for food when the inflammatory process in the lungs is associated with systemic changes.

Tongue Worm.—This condition is found principally in the tongues of swine, however, the parasite is sometimes found in the tongues of sheep. It also occurs in the esophagus of cattle, swine, and sheep.

Etiology and Pathogenesis.—The condition is caused by the *Gongylonema pulchrum*. The male measures up to 6.2 cm. long, while the female may be 14.5 cm. long. The worm is imbedded in a zig-zag or spiral fashion in the mucosa or submucosa.

Lesions.—There are no noticeable lesions since the presence of the worm does not appear to set up any inflammatory change. The presence of the parasite in the tongue can be detected by combing its mucous surface vigorously with a sharp object.

Post-Mortem Significance.—There is no case reported where this condition has affected the disposition of a carcass. It is a localized, non-inflammatory involvement. The affected tongues may be passed for food after removal of the mucosa. This can be accomplished by scalding the tongues thoroughly at a temperature of 145°F. or higher. The scalded tongues are then drenched with cold water after which the mucosa is readily removed. The mucous linings of the esophagus of swine and sheep are not used as edible products. The mucous lining of the esophagus of cattle is saved and processed as one of the animal casings. Since the parasite produces no inflammatory change in the mucosa, the casing is permitted to be used as a container for food.

Sarcosporidiosis.—This condition affects the musculature of all domesticated animals and is caused by a fungus.

Etiology and Pathogenesis.—The *Sarcocystis miescheriana* is usually given as the causative agent although some attempt has been made to identify a different species with each type of animal affected. The sarcocysts occur in muscle tissue anywhere in the body including the heart.

Lesions.—The sarcocyst varies in size from 25 microns to more than 1 cm. in length. As they become large enough to be seen with the naked eye, they appear threadlike and spindle-shaped, lined up in the same direction as the muscle fibers. They vary in color from white to yellow-brown.

Post-Mortem Significance.—A carcass is unfit for food when the involvement is such as to not permit the complete elimination of the affected muscle tissue. When the condition is slight, the carcass is passed for food after elimination of all affected tissue.

Coccidioidal Granuloma. This condition is sometimes confused with tuberculosis and actinobacillosis. It occurs principally in the far western part of the United States, however, cases have been identified in the midwest. It is of some importance as a human disease in the valleys of central and southern California.

Etiology and Pathogenesis.—The *Ascomycete coccidioides immitis* is the causative agent. Little is known of the method of contracting the disease or its transmissibility. The organism is known to occur in the soil and it is thought that the condition is contracted by inhaling the organism with particles of dust. The organism infects the internal organs, principally the lungs and their lymph glands.

Lesions.—Granulomatous processes develop in the lung and its lymph glands resembling tuberculosis and actinobacillosis, principally the latter. Histologically, the lesions are characterized by the occurrence of the spherules of the causative agent in a field of granulation tissue showing occasional giant cells.

Post-Mortem Significance.—Generally, the involvement is slight being localized in the lymph glands. In such cases the carcass is passed for food after eliminating affected organs and glands. A carcass is unfit for food when there is an extensive involvement of the lungs.

Caseous Lymphadenitis. This condition is observed only in sheep and goats on meat inspection post-mortem examinations. It is reported as also occurring in cattle in the form of suppurative lymphadinitis.

Etiology and Pathogenesis.—*Corynebacterium pseudotuberculosis* is the causative organism. The disease principally affects the lymph glands both visceral and body. It also occurs commonly in the lungs. The infection is believed to gain entrance through the skin by way of wounds, such as those caused by shearing, docking, and castration.

Lesions.—Abscesses develop at the site of involvement causing marked enlargement of the affected lymph glands. The pus is greenish-yellow tending to become dry and granular. There is little tendency for the lesions to calcify.

Post-Mortem Significance.—The condition is usually slight and localized in a few lymph glands. In such cases the carcass is fit for food after removal of the affected tissue. Section 11.19 of the Federal Meat Inspection Regulations, page 364 of the Appendix, gives guides for the disposition of sheep carcasses affected with this condition. Those guides give recognition to both the extent of the disease in a carcass and the condition of the carcass as to whether it is thin or well-nourished.

Anthrax. Every effort is made to eliminate on ante-mortem inspection all animals showing any sign of anthrax, not only because such animals are unfit for slaughter for food but it is imperative that the infection with the anthrax organism be kept out of the slaughtering department. Occasionally, cases of anthrax are missed on ante-mortem inspection, particularly those involving the cervical region of swine.

Etiology and Pathogenesis.—The condition is caused by *Bacillus anthracis*. Ruminants are particularly susceptible. In this species, the condition takes the form of a rapidly progressive blood-stream infection. It frequently runs a fatal course in man. Swine are less susceptible, the condition showing a tendency to localize in the cervical region.

Lesions.—In cattle and sheep where the disease runs a septicemic course, hemorrhages occur in various parts of the body, the blood is dark, tarry, and does not clot, the spleen is markedly swollen and is dark red and soft, and there is a characteristic edematous infiltration of the subcutis. In swine where the disease tends to localize in the cervical region, the lymph glands are considerably swollen and hemorrhagic, occasionally there is extensive swelling and hemorrhage in the cervical region accompanied with acute pharyngitis. The lymph glands have a characteristic brick or salmon red color.

Post-Mortem Significance.—Carcasses affected with anthrax are unfit for food. When a carcass is found in the slaughtering department to be affected with anthrax, it is not handled any further on the dressing line but is disposed of immediately. There is prompt disinfection of the area and all equipment which were exposed to the affected carcass during its handling up to the point of condemnation. If a hog carcass is involved, the scalding vat water is immediately drained into the sewer and all parts of the vat are cleaned and disinfected. An effective disinfectant is a 5 per cent solution of sodium hydroxide or commercial lye containing at least 94 per cent of sodium hydroxide. The solution is applied as nearly scalding hot as possible. Every precaution is taken to protect the operator from being burned by this strong caustic solution.

Persons who have handled anthrax-contaminated material immediately cleanse their hands and arms with soap and running hot water. This process of cleansing is most effective when performed by repeated lathering and rinsing. After thorough cleansing, the hands and arms are immersed for about one minute in a 1 to 1000 solution of bichloride of mercury, followed by thorough rinsing.

Anaplasmosis.—Early workers on piroplasmosis or Texas fever of cattle considered the condition now known as anaplasmosis to be a stage in the development of piroplasmosis. The two conditions are entirely different and are caused by different organisms. Anaplasmosis is prevalent in most of the southern States of the United States and it has been reported in some of the northern States.

Etiology and Pathogenesis.—The condition is caused by the sporozoa *anaplasma marginale*. The life history of this parasite is unknown. It only affects cattle and it occurs principally in older animals in which it may run an acute or chronic course. It is a disease of the red blood corpuscles, the sporozoa enter the corpuscles to which they are parasitic.

Lesions.—The condition as it is seen on meat inspection post-mortem examination is evidenced by a progressive anemia and icteric appearance of the carcass. The spleen is usually quite swollen and friable in consistency. Diagnosis is conclusive upon finding the characteristic marginal bodies in the red blood cells.

Post-Mortem Significance.—Carcasses affected with this condition are unfit for food.

Swine Erysipelas. This condition has become quite prevalent in the United States, particularly in the Corn Belt where it has developed into one of the major problems of the live-stock industry. It is sometimes called "diamond skin disease." The skin condition, however, does not characterize all forms of the disease.

Etiology and Pathogenesis.—The condition is caused by *Erysipelothrix rhusiopathiae*. It is believed to infect swine through the digestive tract. Several forms of the disease are manifested; the septicemic type which is

FIG. 18.—Urticarial lesions typical of "diamond skin disease."

the acute form, the chronic form characterized by endocarditis and arthritis, and the form manifesting principally skin lesions from which the "diamond skin disease" term originated.

Lesions.—Accompanying the septicemic form of the disease are hemorrhagic gastroenteritis, marked enlargement of the spleen, swollen and hemorrhagic lymph glands, and petechial hemorrhages on the serous surfaces of organs. There also may be hemorrhages along the ventral portions of the carcass and the lungs may be congested. Also, an icteric condition may develop, usually associated with edematous areas under the serous membranes.

The endocarditis associated with the chronic form is characterized by a vegetative growth on the endocardium. The arthritis produces marked swelling of the affected joints.

The skin form of the disease is urticarial in nature and may be associated with lesions involving the viscera. As the skin form develops, the urticarial

areas usually become necrotic with scab formation; these peel, and raw, sore areas develop.

Post-Mortem Significance.—Carcasses affected with the septicemic form of the disease or the chronic or skin form associated with systemic involvement are unfit for food. In those carcasses where the condition has run its course and has become localized in the skin or arthritic joints, the carcass is passed for food after removal of the affected tissue or part.

Hog Cholera. This is a highly infectious disease of swine characterized by high temperature and rapidly progressive septicemic involvement.

Etiology and Pathogenesis.—The condition is caused by a filterable virus. The virus is thought to gain entrance to the body from contaminated feed and water. The virus produces a blood-stream infection producing septicemic changes as the condition progresses.

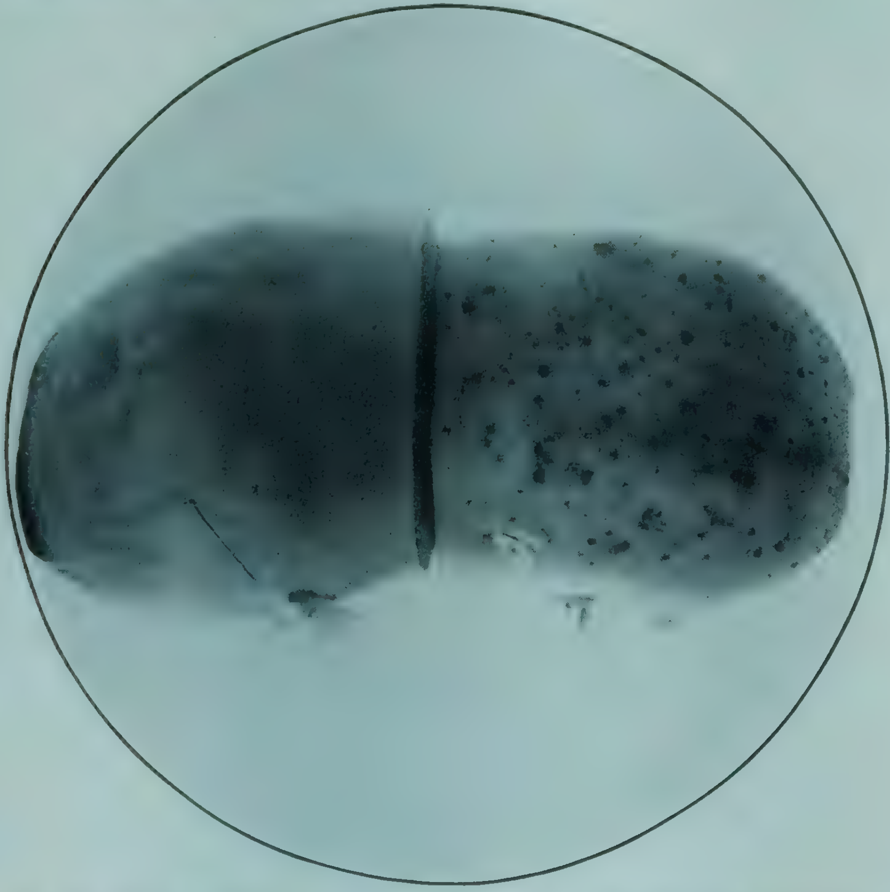

FIG. 19.—Portion of normal kidney on the left for comparison with abnormal "turkey egg" kidney on the right showing hemorrhages typical of hog cholera.

Lesions.—There are small hemorrhages beneath the capsule of the kidneys, in the mucosa of the urinary bladder, and in the mucosa of the larynx and trachea. Small hemorrhages also sometimes occur in the intestinal mucosa and in the lymph glands, spleen, epicardium, and lungs. The kidneys present a typical appearance referred to as "turkey egg" which has been considered characteristic of the condition. Secondary infection sometimes invades the lung tissue to cause pneumonia, and the digestive tract to cause ulcerative enteritis.

Post-Mortem Significance.—Carcasses affected with hog cholera are unfit for food.

Paratuberculosis.—This condition is also called Johne's disease and affects cattle principally. It is reported as also affecting sheep but has not been reported on meat inspection post-mortem examinations.

Etiology and Pathogenesis.—The condition is caused by *Mycobacterium paratuberculosis.* The infection involves the intestinal canal and the mesenteric lymph glands. It usually affects the lower end of the small intestine, the cecum, and the first part of the large intestine. However the condition may extend the entire length of the intestinal tract.

Lesions.—The mesenteric lymph glands do not show any marked change. There is usually only a slight enlargement of these glands. A marked thickening of the intestinal wall characterizes the disease. This results from a diffuse proliferation of epithelioid cells usually accompanied with thickening of the mucous membrane and the submucosa.

FIG. 20.—Thickened intestinal mucosa typical of paratuberculosis.

Post-Mortem Significance.—Carcasses affected with this condition which show any systemic change or emaciation are unfit for food. Usually the condition is localized in the intestinal tract with no apparent effect on the carcass, in which case the carcass is passed for food after elimination of the diseased viscera.

Listerellosis. Animals showing symptoms of this condition are not fit for slaughter as food animals. However, animals which have recovered from the condition are passed for slaughter and their carcasses are presented for meat inspection post-mortem examination.

Etiology and Pathogenesis.—The condition is caused by *Listerella monocytogenes* which invade the central nervous system.

Lesions.—No lesions caused by the condition are seen on post-mortem examination of the carcass of an animal that has recovered from the disease. Histologically, the causative organism, if present, can be identified in sections of involved brain tissue.

Post-Mortem Significance.—Since *Listerella monocytogenes* is known to persist in the brain tissue of an animal that has recovered from the infection, the carcass of such an animal if found otherwise acceptable on post-mortem examination is passed for food after removal and condemnation of the head.

Blackleg.—This condition is generally found in cattle but it may also affect other ruminants.

Etiology and Pathogenesis.—The *Clostridium feseri* is the causative agent. It is believed that the infection occurs through the digestive tract. The infection localizes in muscle tissue, usually in the region of the shoulder or of the rump producing a diffuse swelling.

Lesions.—The affected muscular area is swollen and edematous with a characteristic emphysema. The affected area becomes dark-brown to blackish in color as the condition progresses. It is reported that the lesion possesses a characteristic sweetish-sour, pungent odor.

Post-Mortem Significance.—Carcasses affected with this condition are unfit for food.

Piroplasmosis.—This condition in cattle is commonly called Texas fever. It is tick-borne.

Etiology and Pathogenesis.—*Babesia bigemina* is the causative organism. This organism is transmitted from infected animals to other animals by the tick *Margaropus annulatus*. The organism attacks and destroys the erythrocytes. The changes which occur in the body are those associated with extensive blood cell destruction.

Lesions.—The spleen, liver, and kidneys become swollen and this is accompanied with progressive anemia and icterus affecting the carcass. The most conspicuous change involves the spleen which enlarges up to 4 times its normal size, taking on a reddish-brown color. The bile ducts are engorged and the gall bladder is distended with thick, dark-colored, flocculent bile. The urine is sometimes tinged with blood pigment.

Post-Mortem Significance.—Carcasses affected with this condition are unfit for food.

Vesicular Stomatitis.—This disease affects cattle and occurs rarely in swine.

Etiology and Pathogenesis.—The condition is caused by a filterable virus which produces vesicles on the lips, mouth, and tongue. Also, vesicles form on the udders of cattle occasionally and rarely on their feet.

Lesions.—The vesicles become quite large and when they break the denuded tissue is usually infected by a secondary invader producing sores which gradually heal as the disease subsides.

Post-Mortem Significance.—A carcass affected with this condition in the acute stages or where the carcass shows any systemic involvement is unfit for food. In those cases where the disease has subsided and the condition is localized in the affected part, the carcass is passed for food after removal of the diseased portion.

Vesicular Exanthema.—This condition affects swine principally. Otherwise it is very similar to vesicular stomatitis supra. It is caused by a filterable virus and the lesions are similar to vesicular stomatitis. It has the same post-mortem significance.

Neoplasms.—A large number and a great variety of tumors are encountered in connection with meat inspection post-mortem examinations made in large packing plants where many animals are slaughtered for food. Insofar as affecting the disposition of a carcass is concerned, there are two principal considerations, first, is the neoplasm benign or malignant, second, is the involvement such as to indicate the probability of metastasis. Accordingly, no consideration is being given here to identifying the many kinds of tumors as they are classified according to tissue involved or type of cellular structure in the malignant ones.

Benign Tumors.—The tumors making up this class vary considerably in size and consistency. They are made up of proliferations of a normal body tissue. They are circumscribed, non-inflammatory, and show no inclination to invade the surrounding tissue. After removal of such a tumor, the carcass is passed as fit for food.

Sarcomas.—Malignant connective-tissue tumors make up this class. Sarcomas are highly cellular tumors. The stroma is very scanty and is distributed between the individual cells. The nature of the cells depends on the type of tissue from which the neoplasm has developed. This type of tumor has unlimited powers of growth. It invades the surrounding tissues and spreads by metastasis. Any organ or part affected with a sarcoma is unfit for food. The entire carcass is unfit for food when the neoplasm is extensive or affects the muscles, skeleton, or body lymph glands, or when there is metastasis.

Carcinomas.—These are malignant epithelial tumors. They occur anywhere in the body where there is epithelium, such as the skin, mouth, alimentary canal, glands, bladder, ureter, and so forth. They are rarely found in young animals. The neoplasm forms by the epithelial cells breaking through the basement membrane and extending into the neighboring tissue. Carcinomas possess striking infiltrative powers. They have no definite capsule and their growth is quite irregular. By contrast with the sarcoma, there is no intercellular stroma in the carcinoma. The carcinoma is characterized by groups or islands of epithelial cells imbedded in a connective tissue stroma. The most common carcinoma found in connection with meat inspection post-mortem examinations is epithelioma of the eye of cattle. Page 363 of the Appendix, section 11.13 of the Federal Meat Inspection Regulations gives guides for the disposition of carcasses from animals affected with this condition. Generally, carcasses affected with carcinoma are disposed of the same as those affected with sarcoma, (*supra.*)

Retrogressive Systemic Changes in Very Young Animals. This condition develops during the few days immediately after birth during which the young animal is adjusting itself to its new environment. The condition has significance in calves principally since other species of animals are only rarely slaughtered for food soon after birth. As the retrogressive condition develops, the muscles of the carcass become grayish-red and have a water-soaked appearance, serous infiltration and edematous patches occur in the musculature, and the sublumbar and perirenal tissue become edematous and take on a dirty yellow or grayish-red appearance. There is a tendency for an icteric condition to develop. Carcasses of young calves showing this condition are unfit for food. Care is exercised to distinguish between carcasses affected with this condition and the carcasses of calves

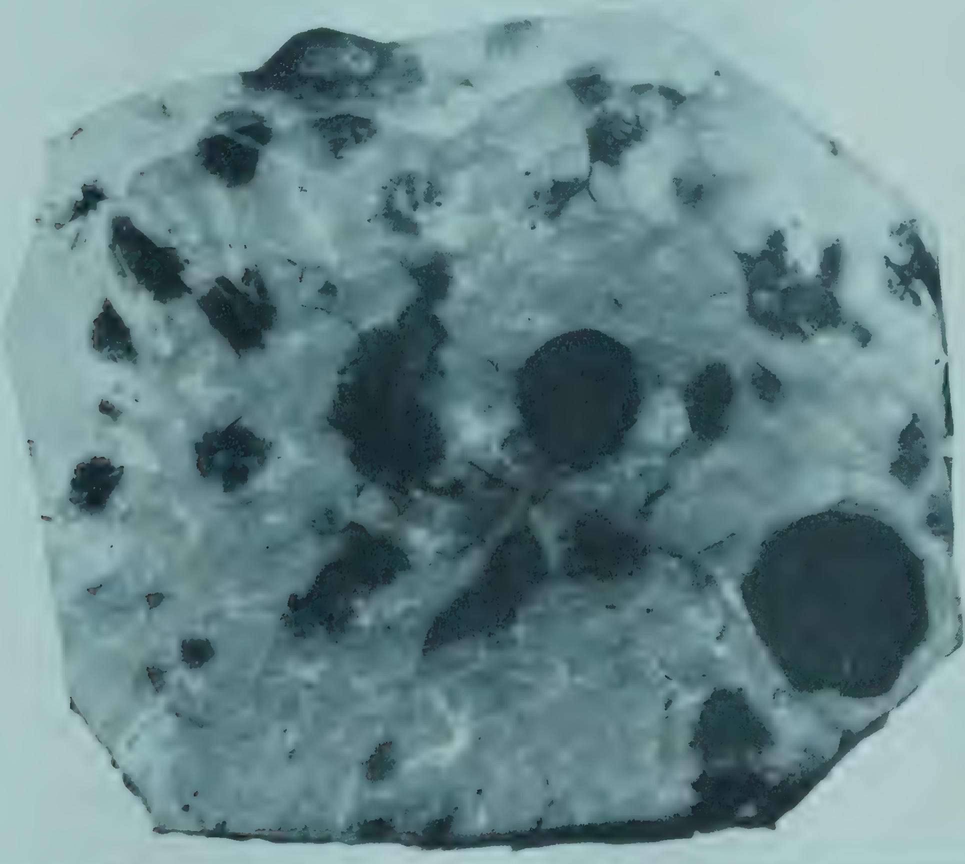

FIG. 21.—Metastatic malignant melanoma in a hog lung—the primary tumor was in the skin.

which have been fed on a fat deficient diet. The absence of fat from the carcass of a calf is not in itself an indication of unfitness for food. Calves which are characterized by merely an absence of fat are generally older than the calves affected with the condition described in this chapter and their musculature is firm and of good color.

Emaciation. This condition is generally observed in old cows. It is probably produced by a combination of causes. Generally, there is no identifiable cause found when the carcass of the animal is examined on post-mortem meat inspection. There is a characteristic slimy degeneration

of the tissues where fat is normally deposited. Also, a serous infiltration of the muscles is sometimes observed. A carcass affected with this condition is unfit for food. Care is exercised to distinguish this condition from mere leanness of a carcass since the absence of fat does not make a carcass unfit for food.

Anasarca. This name is given to a condition which is seen occasionally in cattle, principally in well-fed steers. It is characterized by an edema occurring subcutaneously and intermuscularly in the shoulder region and brisket. The cause of the condition is believed to be dietary and has been attributed to a vitamin A deficiency. The disposition of an affected

Fig. 22.—Carcinomatous growth involving the entire orbital region of a steer.

carcass depends on the extent of the edema. Where the involvement is limited so as to permit removal of the affected tissue, the remainder of the carcass is passed for food. The condition is rarely of an extent which would make the entire carcass unfit for food.

Pale Muscle Tissue.—This condition is observed principally in the carcasses of swine. It is not the condition caused by fat infiltration of musculature (page 80). The pale muscle condition is observed without any accompanying pathological condition. Sometimes the pale muscles are soft and have a watery appearance. Such carcasses may not chill out as firmly as normal muscle tissue.

At one time the pale muscle condition of swine was considered to be a degenerative change. Histologically, there are not sufficient pathological alterations of the muscle fibers to justify calling the condition a degenerative one. A few muscle fibers appear swollen and the cross striations are indistinct. The paleness in color appears to be due to a deficiency in the muscle pigment, myohemoglobin. In this connection it is significant that the myohemoglobin of the pale muscle tissue reacts normally to treatment with sodium nitrite.

Carcasses affected with this condition in which the musculature is normal in all respects except as to the pale color are passed for food.

Pigmentation.—Pigment is either exogenous or endogenous depending on whether it is introduced into the body from the outside or whether it occurs normally in the body.

EXOGENOUS PIGMENTS.—These pigments are introduced into the body of the animal from the outside. Those of importance in meat hygiene enter the body with the food ingested by the animal. They consist principally of the carotinoid pigments. When the carotinoid pigments occur in the body deposited in the fat, they are of meat hygiene significance only insofar as it is necessary to distinguish the condition from discoloration of tissues with bile pigments. This can be readily done by examining the white fibrous connective tissue which retains its white color when the pigmentation is carotinoid in nature. When bile pigments cause the coloration, the white fibrous connective tissue has a yellow cast.

Carotinosis of the liver is caused by the deposit of carotinoid pigments in that organ in an abnormally large amount.

The fitness of a carcass for food is not affected by the deposit of carotinoid pigments in the fatty tisssue. Extensive carotinosis of the liver makes that organ unfit for food.

ENDOGENOUS PIGMENTS.—These are natural to the body and normally take part in its metabolism. They assume meat hygiene significance when they are present in abnormally large amounts or in an abnormal location in the body.

Melanosis.—There are probably several varieties of the pigment melanin which cause this condition. It is the pigment which is basically black and found normally in the skin, the hair, the choroid coat of the eye, the pia mater, and at the base of the brain. The abnormal distribution of this pigment is most commonly encountered during meat inspection post-mortem examinations made on sheep carcasses. It is seen in the connective tissue of the fascias extending deep into the musculature. It is also commonly seen in organs principally the lungs and liver. Organs and carcasses affected with this condition are passed for food after removal of all of the affected tissue. When complete removal cannot be accomplished with certainty, the organ or carcass so affected is unfit for food.

Ochronosis.—The pigment causing this condition is considered to be in the general order of the melanins. Ochronosis is characterized by a black discoloration of cartilages, joint capsules, tendons, and ligaments. It is seen in cattle and hogs. Where the affected tissue can be removed the carcass is fit for food. In those cases where the involvement is so extensive as not to permit removal of all the affected tissue, the carcass is unfit for food.

Osteohemochromatosis (*Porphyria or Pink Tooth*).—This is a yellowish-brown pigmentation of blood origin. The principal pigment is an abnormal porphyrin produced as a result of disarrangement of hemoglobin metabolism. This condition occurs in cattle and hogs where it is characterized by a reddish-brown to chocolate-brown discoloration of the bones. It may also occur in the liver and spleen. Where the affected tissue can be removed, the unaffected portions of the carcass are passed for food. Organs affected with this condition to a slight extent and not associated with any cirrhosis or other secondary changes are passed for food, otherwise they are unfit for food.

Icterus.—This condition is caused by the bile pigment bilirubin. The bilirubin is sometimes accompanied with its oxidized form, biliverdin. This pigmentation is characterized by a bright yellow discoloration of all of the body tissues noticeable principally in those tissues which are normally light-colored, such as adipose tissue and white fibrous connective tissue. The degree of discoloration varies from a very slight yellow to a decided greenish-yellow. Icterus is associated with many infectious and inflammatory conditions affecting animals. The significance of icterus with respect to those conditions has been discussed in connection with each. Carcasses are unfit for food when the discoloration is well marked. When the discoloration is slight and disappears on chilling the carcass, it is passed for food provided there is no other condition which would require a different disposition.

Xanthosis (Brown Atrophy of the Musculature).—This is essentially a discoloration of musculature resulting from deposition of excessive quantities of waste pigment. The degree of atrophy is variable. It is usually found in old cattle and is most noticeable in the muscles of the heart, the masseter muscles, and in the tongue. When this condition results in an extensive discoloration of the musculature of the carcass, it is unfit for food. Where the condition is slight and localized, the carcass is passed for food.

Offensive Odor.—Carcasses occasionally exhibit abnormal odors which in some cases are offensive. The offensive odors which affect the disposition of carcasses on meat inspection post-mortem examinations come within two categories: those traceable to materials ingested by the animal, and the odor known as sexual odor in swine.

The most common offensive odor traced to feed ingested by food animals is often described as being fishy in nature. It is assumed that this fishy odor occurs in the carcasses of animals which have been fed fish meal or other feed of fish origin. Occasionally, a distinct garlic odor is detected in a carcass. This generally occurs in the spring and is thought to be produced by a generous feeding of wild garlic. Also, certain drugs which have been administered to the animal prior to slaughter impart to its carcass an odor characteristic of the particular drug.

Carcasses which have an offensive odor are not fit for food. Occasionally, the odor which is detected at the time of slaughter will disappear upon chilling and holding the chilled carcass for a period of time. In any case, a carcass which is retained for having an offensive odor is not passed for food until a test is made of a representative portion of its fat and muscle tissue by heating.

Sexual.—An offensive sexual odor is sometimes detected in carcasses of boars and recently castrated stags. Care is exercised to distinguish this condition from an odor which is imparted to a part of a carcass by contamination with smegma from the prepuce.

Some carcasses that exhibit sexual odor will lose the odor after the carcass is chilled and held for a period of time. Here again no such carcass is passed for food until a test has been made of representative portions of fat and muscle tissue by heating. A carcass which has a sexual odor is unfit for food. The portion of the carcass which has been contaminated

with smegma is eliminated by trimming and the clean portion of the carcass is passed for food. Washing of a carcass that is in part contaminated with smegma is not attempted since such handling would spread the contamination and require trimming of a larger portion before the carcass is passed for food.

Mesenteric Emphysema of Hogs.—This condition is characterized by the presence in the mesenteric fat of numerous air-filled cysts occurring both singly and in grape-like clusters. The cysts very considerably in size from a pinpoint to approximately 1 inch in diameter. They are tightly filled with air and are usually transparent.

The cause of this condition has not been definitely established. It is benign and non-inflammatory. It appears to have no effect on the animal or the tissues where the cysts are located.

This condition does not affect the disposition of a carcass which is passed as fit for food. It interferes somewhat with the handling of the small intestines in connection with their preparation for use as animal casings.

Liver Conditions.—*Cirrhosis.*—This is observed most commonly affecting the livers of swine on post-mortem meat inspection. It is characterized by a proliferation of the interstitial tissue which eventually takes on the characteristic of cicatricial tissue. The liver is firm in texture and its surface sometimes becomes rough, having a characteristic "hobnail" appearance. Livers affected with this condition are unfit for food.

Carotinosis.—Carotinoid pigmentation of the liver is quite common in cattle. When this pigmentation is extensive and produces a highly colored yellow condition throughout the liver and its lymph glands, the liver becomes enlarged and friable. The pigment stains the hands and other objects which the affected liver contacts. Such a liver is unfit for food.

"Sawdust" and Telangiectasis.—So-called "sawdust" and "telang" lesions are considered as representing different stages of a focal hepatitis and its termination. These lesions are seen in cattle livers, the typical telangiectatic lesions usually occurring in the livers of older animals.

According to Getty (1946) areas of capillary congestion represent the first stage of the focal hepatitis. In subsequent stages there is degeneration of the hepatic parenchyma (focal necrosis) and a localized inflammatory reaction producing the characteristic "sawdust" lesion. The typical telangiectatic lesion represents the final stage or termination of the process following resolution of the "sawdust" lesions. No evidence is found that infection is associated with the process which progresses to the "sawdust" and telangiectasis stages.

The "sawdust" lesion is pinkish-white to yellow-gray and is variable in distribution. The area surrounding the lesion appears normal. The surface of the liver over the lesion is smooth and no proliferation of tissue or hypertrophy is evident on palpation.

The "sawdust" lesion gives way to a dilatation of the hepatic sinusoids during resolution and repair by regeneration. This develops into the telangiectasis lesion which is purplish-black to reddish-blue and the lesions vary greatly in size. The lesions consist of tar-like blood and have a cavernous appearance. They are definitely circumscribed areas ranging from those which are readily overlooked to large areas which contrast

markedly with the surrounding normal liver tissue. There is no encapsulation or other apparent reaction of the surrounding tissue noticeable to the unaided eye. The areas are not elevated above the surface of the liver, in fact, some of the larger ones may be slightly sunken. Section 11.33 of the Federal Meat Inspection Regulations, Appendix page 367, gives guides for use in the disposition of "sawdust" and telangiectasis livers.

Abscesses. This is a very common condition affecting livers of all species. The abscesses are caused by a variety of etiological factors, frequently being associated with specific disease conditions but generally occurring as a localized liver condition. The occurrence of liver lesions in connection with specific disease conditions has been mentioned in the consideration given to the particular condition. In all cases, a liver containing an abscess is unfit for food.

Gallstones. Gallstones are commonly observed in the gall bladder of cattle. They are generally present without any accompanying inflammatory or secondary change. Frequently, the mucous membrane of the gall bladder is slightly thickened and sometimes the bladder itself is somewhat distended.

The condition is benign and localized, and it is only rarely accompanied with any inflammatory change. Gallstones are saved by the packing industry and it is understood that they have some value as charms in the Orient.

Abrasions, Bruises and Abscesses. Abrasions are of significance principally in hog carcasses because these carcasses are dressed with the skin on. They are also encountered, however, on the tongue and inside the cheeks of all species. The abrasions are usually localized inflammatory conditions associated with some degree of infection. The affected tissue is removed and handled as inedible. Abrasions sometimes do become infected to a degree involving extensive inflammatory changes. In such cases, careful examination of the carcass is made to detect any systemic change which might be evidence of absorption of toxic substances from the infected area. Where there is evidence of such systemic involvement the carcass is unfit for food.

Bruises varying considerably in degree and location are commonly found in many carcasses of all species on meat inspection post-mortem examinations. They are generally localized and circumscribed which permits the affected tissue to be removed and handled as inedible. In such cases the carcass is passed for food. Extensive bruises sometimes associated with bone fractures are occasionally encountered located in the thigh of swine carcasses. Sometimes these conditions are deep and not readily observed on the surface of the carcass. Evidence of such condition, however, shows itself by a hemorrhagic appearance of the lymph glands draining the area. Generally, there is no systemic involvement associated with bruises, however, occasionally there is found such extensive tissue destruction caused by contusions as to affect the entire carcass which is then disposed of as being unfit for food.

Abscesses are encountered in many locations throughout the carcass and its viscera. Those which occur in connection with a specific infectious condition have been mentioned in discussions concerning those conditions.

Frequently, the abscess is not associated with any other condition in the carcass, but is a localized, circumscribed involvement. In such case the carcass is passed for food after elimination of the affected tissue or organ.

Sapremia and Toxemia.—These toxic conditions are considered together inasmuch as they have comparable significance with respect to meat inspection post-mortem examinations. Furthermore, it is very nearly impossible to distinguish between the two conditions on such examination.

From the point of view of meat hygiene these conditions are systemic manifestations indicating the extent to which a carcass is affected by some primary condition. Generally, the primary condition is the one which is identified as the cause for condemnation of the carcass. When there is any evidence in a carcass of sapremia or toxemia, it is unfit for food.

Uremia.—This condition is also encountered as a manifestation of a primary condition, usually involving the kidneys. Theoretically, it might occur as a result of the retention of urine caused by an obstruction of the urethra. The condition is detected by its offensive urinous odor. A carcass so affected is unfit for food.

Pyemia.—This condition as it is found on meat inspection post-mortem examinations is characterized by the occurrence of multiple abscesses generally distributed throughout one or both body cavities. There is usually a primary seat of infection from which the pyogenic organisms were distributed in the blood stream to the secondary locations. A carcass so affected is unfit for food.

Urticaria and Erythema.—These abnormal skin conditions occur in connection with both infectious and parasitic conditions. Their significance has been considered in discussions of these conditions.

Urticaria and erythema sometimes occur as localized skin conditions as the only abnormal condition affecting the swine carcass. They are of significance only in disposing of swine carcasses since such carcasses are dressed with the skin on, the skin forming part of the edible portions of the carcass. When these conditions occur, the affected tissue is removed and the carcass, if otherwise acceptable, is passed for food.

General Inflammatory Conditions.—In those cases where the inflammatory conditions which are listed under this heading occur in connection with a specific infectious or parasitic condition, they have been mentioned in discussions of those conditions. Occasionally, there is an inflammatory process involving a particular organ or part as the primary condition.

Mastitis.—The udder is a common seat of infection in cows which are slaughtered for food purposes. Generally, the udder is discarded as an article of human food, in which case only those inflammations of this organ that are accompanied with systemic involvement are of significance. A carcass so affected is unfit for food. Mastitis in any degree makes the organ unfit for food.

Gastritis.—Inflammations involving the mucosa of the stomach are of significance only if they are diffuse and acute in which case they are invariably accompanied by systemic changes that make the carcass unfit for food. The swine stomach and the first two stomachs of cattle are the only ones generally saved for human food. These are scalded as part of their preparation which treatment completely removes the superficial

mucous membrane. Small areas of hyperemia occur quite commonly in these stomachs, however, such involvement is considered to be unimportant from the point of view of meat hygiene in view of the method used in preparing the stomachs for food. Abscess of the reticulum is a common condition resulting from injury by foreign bodies which accumulate in this organ. An abscessed reticulum is unfit for food.

Enteritis.—Like gastritis, this condition has significance with respect to the disposition of the carcass only when the inflammation is acute and diffuse and associated with systemic manifestations. A carcass so affected is unfit for food.

Chitterlings are the only intestines prepared as an article of human food. They are the large intestines of swine. Commonly, an area of inflammation occurs near the iliocecal opening in the large intestine of swine. The affected area is removed when this intestine is used in the preparation of chitterlings.

Pneumonia.—Bronchial pneumonia is quite common in all species. It may be produced by many causes. All affected lungs are unfit for food. The condition makes the carcass unfit for food when the pneumonia is of such extent as to be associated with systemic changes.

Lobar pneumonia occurs less frequently and is most commonly observed in swine. It is usually associated with systemic involvement which makes the carcass unfit for food.

Pleuritis.—Localized resolved areas of pleuritis are commonly observed in all species, associated with adhesions varying considerably in extent. There may also be localized abscess formation. Such conditions being localized permit passing the carcass for food after removal of the affected part. Occasionally, acute, diffuse inflammation of the pleura occurs associated with systemic change which makes the carcass unfit for food.

Pericarditis.—Inflammation of the pericardium is principally observed in cattle as a result of foreign body penetration from the reticulum. Occasionally, the condition is localized with the formation of adhesions. Sometimes there is localized abscess formation. Frequently the inflammation is acute, diffuse, and purulent, and associated with systemic change making the carcass so affected unfit for food.

Nephritis.—As a primary condition, nephritis occurs occasionally as a focal suppurative condition in swine and, rarely, in old cattle. In swine the condition is believed to be the result of housing swine under filthy conditions. The infection is thought to work its way up the urinary tract to the kidney where an inflammation of the hilus and tubules occurs. It produces an enlargement of the affected kidney with accompanying accumulation of pus. The condition tends to localize, in which case the carcass is passed for food after removal of the affected tissue. The carcass is unfit for food if the condition is accompanied with systemic change.

There is a benign condition affecting the kidneys of young calves which is characterized by the occurrence of light-colored to white embolic areas throughout the body of the kidney. This condition has been called fibroplastic nephritis and it appears to have no effect on the health of the animal since the condition is usually seen in carcasses of good condition. In fact, the kidney appears to be functioning normally. Kidneys so affected

are unfit for food and after their elimination, the carcass, if otherwise acceptable, is passed for food.

Metritis.—Inflammations of the uterus are commonly encountered in conducting meat inspection post-mortem examinations of cows. The degree and kind of inflammation vary considerably. Also, the condition may be accompanied with a retained dead fetus or placenta. If the condition is localized and not associated with systemic change, the carcass is passed for food. In any case all uteri are handled as inedible. Where the inflammation is acute and diffuse and associated with systemic change, the carcass is unfit for food.

Arthritis.—As a primary condition, an inflammation of a joint is usually caused by an injury. This is a localized condition and a carcass so affected is passed for food after removal of the affected tissue.

Omphalophlebitis.—This condition is sometimes called navel ill and affects young calves. The infection gains entrance through the umbilical cord setting up an abscess at that point and frequently becoming systemic producing arthritis in one or more joints as part of the systemic involvement. Carcasses showing systemic manifestations are unfit for food. Where the condition resolves itself as a localized abscess in the umbilical region, the carcass is passed for food after elimination of the affected tissue.

Hyperkeratosis.—This condition which is sometimes referred to as "X" disease of cattle is discussed under "Ante-Mortem" on page 25.

Lesions.—Ulcers are found in various parts of the mouth and sometimes on the muzzle, and at the entrance to the nostrils. The nasal mucosa is reddened. Ulcers also may be found in the pharynx, larynx, and esophagus. The stomach mucosa may be reddened or may contain petechiæ and a few ulcers. The small intestine may have a diffusely reddened mucosa but the intestinal lesions are generally not severe.

Post-Mortem Significance.—When the condition is localized and not accompanied with systemic change, the carcass is passed for food after the removal of the affected parts. Otherwise the carcass is unfit for food.

Selenium Poisoning.—This condition is discussed under "Ante-Mortem" on page 24. The animal is not passed for slaughter unless it has responded to treatment for correction of the condition.

Lesions.—New growth of the horny tissue of the foot is seen pushing off the old horn. There is a distinct line of demarcation between the two. Eccymotic spots may be seen on the epiglottis. A catarrhal inflammation may be present affecting the stomach. There may be areas of inflammation in the intestinal tract.

Post-Mortem Significance.—A carcass showing viscera lesions is unfit for food since such lesions are an indication that the toxic effect of the poisoning had not been corrected. A carcass showing no visceral lesions or systemic involvement is passed for food.

Fluorine Poisoning.—This is discussed under "Ante-Mortem" on page 25. The condition is characterized by an interference with calcium metabolism.

Lesions.—The disturbed osseous metabolism results in great thickening and exostosis of the long bones and mandible. The ribs are flattened and enlarged. There is extensive abrasion of the molars and premolars.

Hypoplasia of the enamel occurs. Degenerative changes occur in the liver, heart, kidney, and adrenal glands.

Post-Mortem Significance.—The carcass is unfit for food when degenerative changes are present in its organs. When the carcass is from an animal which has responded to treatment and no abnormality is found in its organs, it is passed for food after removal of all abnormal bones. The damage done to bones and teeth by the fluorine poisoning is not reversible even though the concentration of fluorine in the body is reduced to normal.

Icterohemoglobinuria in Sheep.—This condition occurs enzootically in sheep and is sometimes called "enzootic jaundice." It is also called hemolytic icterohemoglobinuria.

Etiology and Pathogenesis.—The condition appears to be due to a disturbance of copper metabolism associated with high storage values for copper in the liver and a sudden mobilization of copper in the blood stream. The condition occurs in the absence of excessive intake of copper and its manifestations are the same as the condition which results from chronic copper poisoning caused by long-continued ingestions of salt mixtures containing copper sulphate. The condition appears to be precipitated by a falling plane of nutrition such as might occur during shipment as a result of excessive exercise or a sudden check of food intake.

Lesions.—The condition is characterized by a true icterus accompanied with swelling of the spleen and degenerative changes in the liver and kidney.

Post-Mortem Significance.—A carcass affected with this condition is unfit for food.

Osteomyelitis.—This is an inflammation of the bone marrow and is most commonly seen in swine. However, it occasionally occurs in cattle.

Etiology and Pathogenesis.—Pyogenic organisms invade the bone marrow probably as a result of some predisposing factor.

Lesions.—The ribs are most frequently affected. The bone marrow is hyperemic with pus permeating the marrow cavity. As the condition progresses the resulting inflammation stimulates the production of new bone by the periosteum causing the bone to become enlarged.

Post-Mortem Significance.—The carcass is unfit for food when the inflammation of the bone marrow is accompanied with secondary changes in such organs as the liver, spleen, or kidneys, or accompanied with any other systemic change. In the absence of organ involvement or systemic change, the carcass is passed for food after removal of the affected parts.

Steatosis.—This condition is also called lipomatous atrophy and affects the muscle tissue of cattle. It is a non-inflammatory condition characterized by displacement by fat of a portion of the musculature. There is no swelling or atrophy to give notice of the presence of the fatty tissue. It is generally seen only when cut into as the carcass is being cut up into its various parts.

Post-Mortem Significance.—The presence of this condition does not influence the fitness for food of a carcass which is passed for food after removal of the abnormally located fatty tissue.

Chapter

5

TRICHINOSIS

General.—Trichinosis presents a special meat hygiene problem principally because examinations made macroscopically of swine carcasses do not detect the condition and trichinosis is a serious affliction of man. The infective parasite is microscopic and its presence in pork muscle tissue does not produce a condition which can be seen by the unaided eye. Trichinosis affecting the muscle tissue of swine is caused by the larval form of the roundworm parasite *Trichinella spiralis*. When an individual consumes pork containing viable larvæ, the life cycle of the parasite will be completed in the new host resulting in infestation of the muscle tissue of the new host by its larvæ. The infestation may result in a wide range of clinical symptoms. These symptoms may be slight and barely noticeable, however, the infestation may cause severe, excruciating pain, prolonged illness, and death.

The prohibition contained in the Talmud against eating pork is probably an early recognition of the occurrence of illness traceable to eating raw pork. If that is the case, it is the earliest clue to the existence of trichinosis.

Recognition of the trichina parasite in modern times dates from 1835 when it was discovered in England by Paget and described by Owen on the basis of Paget's discovery. The first report in the United States was made around 1842 by Bowditch who found the parasite in performing necropsies on human bodies. Leidy's discoveries in 1847 in connection with his work on hogs stimulated in the United States work on diagnosis of trichinosis and resulted in the first nation-wide survey of the incidence of the trichina parasite in man. In 1880, outbreaks of trichinosis in Germany received nation-wide attention in that country. This led to the exclusion, by Germany, of importations of pork from the United States. The resulting Federal legislation in the United States was the first of a series of enactments by the Congress which led up to the passage of the Federal Meat Inspection Act of 1906.

Trichinella spiralis.—This parasite is a roundworm, the adult form of which occurs in the small intestine of man, swine, rat, and many other mammals. The male is 1.4 to 1.6 mm. long and the female is 3 to 4 mm. long. The body is slender and the esophageal portion is only slightly narrower than the posterior portion. The male has a pair of lateral flaps on either side of the cloacal opening at the posterior end with two pairs of papillæ between the flaps. The vulva is situated near the middle of the esophageal region in the female. The eggs measure 40 by 30 microns and contain fully developed embryos. The larvæ measure from 5 to 6

microns in diameter and from 80 to 120 microns in length when they are deposited by the female parasite, and grow to 0.8 to 1 mm. in length after they reach their final location which is preferably in skeletal muscle.

Trichinosis.– Within a few hours after the meat containing viable larvæ is ingested, the parasites are liberated from their cysts and penetrate the mucosa of the small intestine. Here they may produce symptoms of enteritis in the human. In about three days these larvæ develop into sexually mature adult parasites of the intestinal form. After copulation takes place the male dies and the gravid female penetrates deeply into the mucosa. Here the larvæ are deposited in the mucosa or in the central

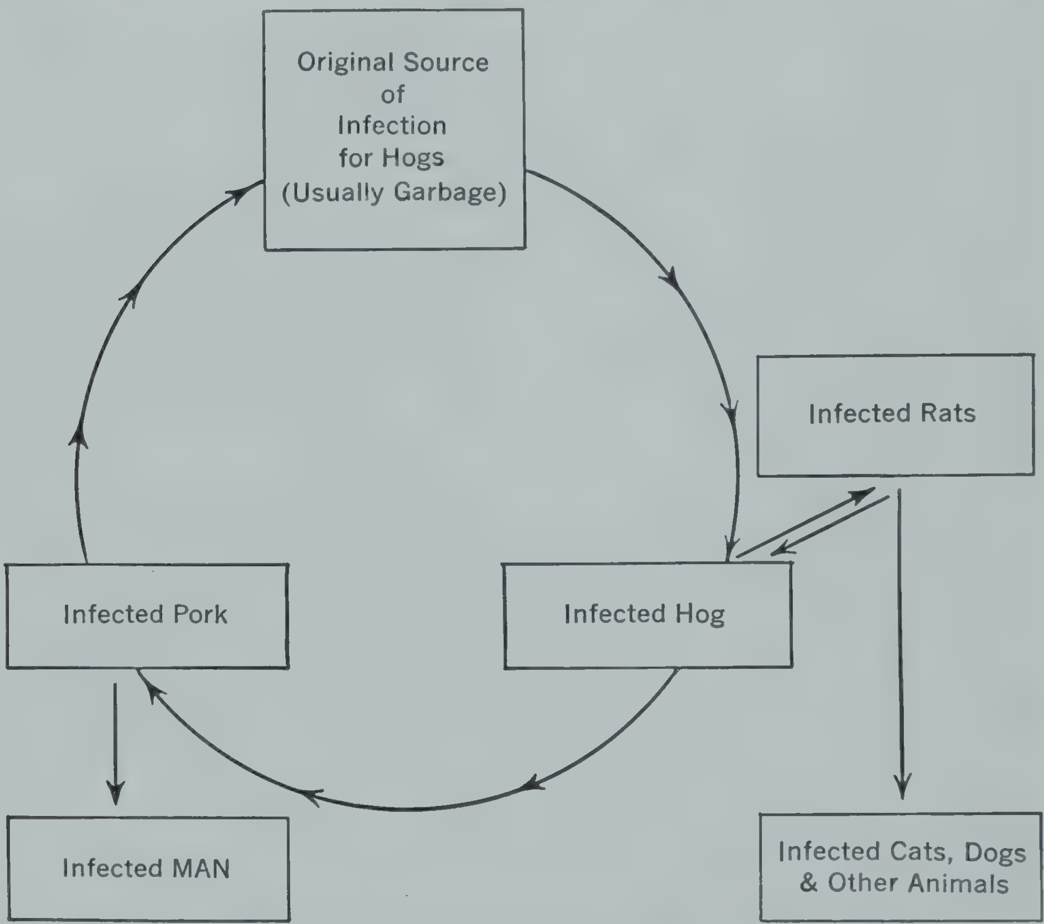

Fig. 23.—Diagram illustrating the common method of exposures to trichinosis in the Continental United States. (Faust, Human Helminthology.)

lacteals. The females live for about six weeks, each giving birth to more than 1,000 larvæ. In animals, the larvae are deposited four or five days after the gravid female has entered the mucosa. This is believed to take about seven days in man.

The larvæ pass through the intestinal lymphatics on to the thoracic duct. From here they enter the general circulation and are distributed throughout the body. They prefer to locate in skeletal muscle, especially the muscle of the diaphragm, tongue, larynx, muscles of mastication and intercostal muscles. These larvæ may, however, invade the heart, the central nervous

system, and the lungs. The time lapsing between infection and muscle penetration by the larvæ is variable. Larvæ may begin to reach the muscles eight days after ingestion of the infested material but, generally

FIG. 24.—Trichinella spiralis. *A*, Adult male × 90; *B*, adult female; *C*, larva × 660. (From Faust. *A* and *B* after Yorke and Maplestone's Nematode Parasites of Vertebrates, courtesy of J. and A. Churchill, Ltd. *C*, Adapted from Stäubli.)

this takes fifteen days after infection. After they reach the muscle tissue they penetrate the sarcolemma of the muscle fibers where they grow rapidly. Within ten days to two weeks, they reach their full growth during which time they become spirally coiled. When they have attained their full growth, they have reached the infective stage. In three to six weeks a membranous capsule begins to form around the worm. The cyst so

formed is ovoid and lemon-shaped, and may contain from 1 to 5 coiled larvæ. The life of the larvæ is quite variable since they remain alive in some cases for several years. Usually, calcification of the cyst wall begins to take place in less than a year, although several years may be required for complete calcification. When the larvæ die, they too may become calcified, or they may be absorbed.

The presence of larvæ in pork muscle tissue usually has little effect on the surrounding muscle fibers. This circumstance along with the microscopic size of the parasite precludes detection of the condition in pork muscle tissue by macroscopic examination.

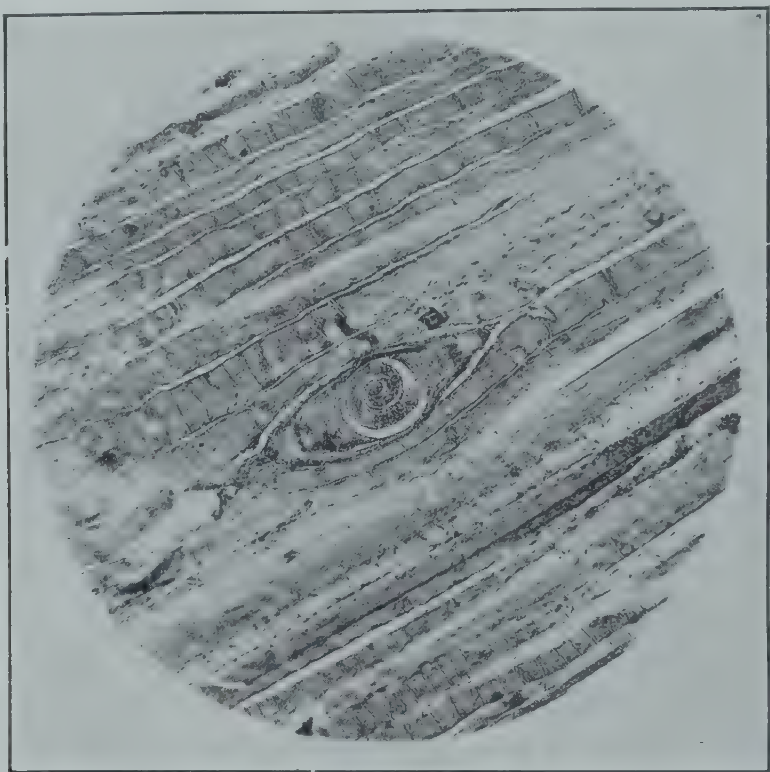

Fig. 25.—Encysted T. spiralis in lean pork meat. (Aldrige, Amer. Jour. Med. Sci.)

In man, the reaction of the muscle tissue to the larvæ is characterized by many degenerative changes. This is accompanied with hyperemia, proliferation of endothelial cells, edema, and an inflammatory cell infiltration of neutrophilic polymorphonuclear leukocytes, lymphocytes, and tissue histiocytes and occasionally plasma cells. The muscle tenderness and soreness are thought to bear a direct relation to the severity of this interstitial myositis.

Clinical. The two quotations that follow are taken from the 1941 and 1942 Reports of the New York State Trichinosis Commission.[1] They describe the clinical picture of trichinosis as it is seen in man.

[1] The New York State Trichinosis Commission was created by an enactment of the New York State Legislature in 1940 entitled "An Act creating a temporary State Commission to study the problem of trichinosis and other diseases contracted by eating affected meat and making an appropriation for the expenses of such commission." The life of the Commission extended for the two years 1941 and 1942.

"The symptoms of trichinosis are very diverse and may affect any system of the body with the possible exception of the reproductive system. The intensity of the disease is extremely variable and is dependent for the most part on the degree of infection and the resistance of the individual. Thus, one may encounter all gradations of symptoms ranging from a mild, almost sub-clinical syndrome to those characterizing a severe, fulminating fatal infection. Because of this, it is not surprising that all cases of the disease are not readily recognized and that the symptoms are sometimes confused with those of half a hundred other diseases which they may simulate."

"The difficulties in diagnosis are well exemplified by two outbreaks investigated by Dr. F. J. Brady and J. Bozicevich of our staff[2] during the past year (1941). In one of these outbreaks the diagnoses were progressively influenza, poliomyelitis, and lymphocytic choriomeningitis, diagnoses which appeared justified on clinical grounds because of the close similarity of the symptoms exhibited by some of the patients to those of these diseases. The condition was finally recognized as trichinosis by the county health officer who had recently returned from a year's postgraduate work during which he had attended lectures and demonstrations on this disease. The cases in the other outbreak were variously diagnosed by the family physician and four consulting physicians as colitis, appendicitis, and la grippe. One of the patients who was hospitalized was suspected of having bacillary dysentery because of the severe diarrhea. Here again the symptoms were quite similar to those of the conditions mentioned and naturally led to the diagnoses in question.

"In a paper describing 19 clinical cases of trichinosis treated at the Mayo Clinic, Wyrens, Tillisch and Magath noted the original diagnosis which was made in each case by either the referring physician or the physician who first saw the patient in the clinic. Trichinosis was diagnosed six times, nephritis twice, indeterminate diarrhea twice, unstated infectious processes twice, and conjunctivitis, sinusitis, traumatic headache, secondary anemia, encephalitis, neurosis and migraine once each."

Incidence.—*Swine.*—Under the heading "Incidence of the Parasite in Swine" on page 31 of the 1942 Report of the New York State Trichinosis Commission, appears the following:

"In the Bureau of Animal Industry studies, Schwartz[3] reported for the fiscal year ended June 30, 1941, the examination for trichinæ of 1,300 farm-raised hogs reported to have been fed principally grain. Only 13 or 1 per cent, were found to be infected, the number of larvæ in the individual diaphragms ranging from 3 to 2,400. Of 294 diaphragms from hogs fed wholly or in part on garbage as collected, 32, or 10.9 per cent, were infected, the number of larvæ in the individual diaphragms ranging from 1 to 108,000. Summarizing the reports of this survey to date, an incidence of 6.2 per cent was obtained in approximately 12,000 hogs fed on raw garbage, an incidence of 0.8 per cent in approximately 22,000 so-called grain fed hogs and an incidence of 0.4 per cent in approximately 2,800 hogs fed on cooked garbage.

Human Beings.—In his introduction to the Commission's Report of 1942, New York State Senator Thomas C. Desmond, as Chairman of the New York State Trichinosis Commission, states that trichinosis is far more prevalent than has been generally believed. He goes on to say on page 14 of the Report that "the small number of trichinosis cases reported to the United States Public Health Service by State Health Departments—

[2] This was taken from the part of the 1942 Report contributed by Dr. Willard H. Wright, Chief, Division of Zoology, National Institute of Health, U. S. Public Health Service.

[3] Dr. Benjamin Schwartz is Chief of the Zoological Division, Bureau of Animal Industry, United States Department of Agriculture.

only 4,543 from 1842 to 1936—is no adequate index to the prevalence of the disease in the United States."

The incidence of trichinosis in the United States has been considered to be more accurately expressed by findings made over a period of years in connection with examining diaphragms of individuals on which necropsies have been made throughout the country. A complete report of these examinations is given in an article entitled "Studies on Trichinosis" which has been published in the Public Health Reports under date of May 26, 1944, *59*, No. 21. This is a report of examinations made of diaphragm material from 5,303 individuals coming to necropsy of which 855, or 16.1 per cent, were found positive for the parasite.

Control.—Because trichinosis does not lend itself to be detected and handled like other parasitic conditions in connection with meat inspection post-mortem examinations made of swine carcasses, it is necessary to devise some other method of control which would safeguard the consuming public against this parasite. Considerable study has been given to this problem by agencies such as the U. S. Public Health Service and the United States Department of Agriculture and those State offices in the United States which have meat hygiene responsibilities. Methods of control employed in countries outside the United States are not being considered in this text since they must be considered to have only academic interest as applying to conditions differing sharply from those encountered in the United States. Since the hearings and surveys conducted by the New York State Trichinosis Commission and the Committee on Public Health Relations of the New York Academy of Medicine have gone thoroughly into an evaluation of the various methods of control, the following contains many quotations from the reports made by those groups.

Garbage Treatment.—The New York State Trichinosis Commission in its report of 1942 states, in connection with statistics giving the incidence of trichinosis in garbage fed hogs, that "these figures which are based on careful epidemiological studies indicate that in the territory covered, rodents play only a minor role in the transmission of trichinosis to swine and that the feeding of raw garbage is a much more important factor in maintaining the disease."

The following is quoted from the Commission's 1941 Report:

> "Human trichinosis is based almost entirely on porcine trichinosis. And porcine trichinosis is based almost entirely upon feeding hogs raw garbage containing trichinæ infested pork scraps. 'The common occurrence of pork scraps, including those not so cooked or processed as to kill trichinæ, in garbage and swill, and the eating of such scraps by large numbers of swine, are well-established facts,' Dr. Hall[4] pointed out. 'Americans throw into the garbage cans much more food than is thrown away by other nations, and as they rank about fifth in amount of meat per capita purchased, the discarded food includes a great deal of meat. This is especially true of so-called hotel garbage, which is definitely high in discarded meat, although the less valuable alley garbage, the household garbage, contains more meat in the United States than it does in other countries.
>
> 'It is the testimony of the field veterinarians of the Federal Bureau of Animal Industry that pork scraps are usually present in garbage and swill.

[4] Before his death in 1938, Dr. Maurice C. Hall was Chief, Division of Zoology, National Institute of Health, U. S. Public Health Service.

The veterinary field force engaged in hog-cholera control has paid special attention to this subject for many years in tracing outbreaks of hog cholera; and in the State of Maryland, where this subject was given particular investigation by Dr. I. K. Atherton and his field force, approximately 80 per cent of outbreaks of hog cholera were traced to garbage containing uncooked pork scraps. The extent of garbage feeding varies locally in accordance with the amount and kind of feed available, and over the Middle West, with plenty of grain available, there is relatively less garbage feeding than along our seaboards. It varies also with the price of pigs above 6 cents a pound, garbage feeding is profitable in Maryland, and with prices below 6 cents it is not profitable. The precise critical price would vary with different swine growers and other factors.

'There are, usually, approximately thirty million to forty million hogs slaughtered annually in the United States, and the scraps of pork from these millions of hogs are trimmed out in butcher shops, hotels, homes, and elsewhere for various reasons—spoilage, discoloration, etc.—and these trimmings and other discards are thrown into the garbage. Between 1 and 5 of every 100 of these discards, on an average, will contain live trichinæ, and the total scraps, from almost 100,000 hogs daily, which will contain live trichinæ from approximately an indicated 1,000 to 5,000 infested hogs, will run into many thousands daily. The feeding of swine of such scraps, as constituents of garbage or swill, constitutes a dependable, large-scale, year-round source of trichinæ for swine. At times the feeding of pork scraps in garbage takes the form of a case reported in the New Jersey press in 1933, in which part of the sausage responsible for 28 clinical cases of human trichinosis, with at least 1 death, was thrown into garbage cans and the garbage distributed to many hog pens.'

"Geographical areas in which many hogs are raised on garbage are the areas having the most cases of clinical trichinosis.

"Dr. Willard H. Wright, of the National Institute of Health, reports that there is 'even some further correlation between the percentage of cities feeding garbage to hogs and the trichinosis morbidity rate. For instance, the Pacific Coast States, in which 82.8 per cent of the cities concerned dispose of garbage by feeding it to swine, have the highest morbidity rate of any section. The New England States, with the next highest morbidity rate, lead all other geographical areas in the number of cities using the hog-feeding method of disposal.'

"Swine fed on cooked garbage and Southern swine raised generally in fields and woods without easy access to garbage or kitchen scraps rank in the lowest order of importance as sources of human trichinosis. Only about 0.5 per cent of these swine have been found to harbor trichinæ.

"Next in order of importance are so-called grain-fed swine, as represented largely by swine from the Central West, of which 1.05 to 1.5 per cent have been found infested with trichinæ. If we exclude the rat as a major factor in the causation of swine trichinosis, it is apparent that these so-called grain-fed swine have not been raised exclusively on grain or on pasture crops but that many of them have received some garbage probably in the form of scraps or swill from the farm kitchen.

"Swine fed on uncooked garbage rank next in the order of importance as a source of human trichinosis and probably today (1942) represent the chief source of the disease in man. Since 4.5 to 5.0 per cent of these swine are infested with trichinæ, they are approximately 10 times more important as a source of trichinosis than are Southern swine and swine fed on cooked garbage."

Again quoting from the 1941 Report of the Commission appears the following under the heading "Prevention of Feeding of Raw Garbage."

"The situation today plainly indicates," Dr. Wright states, "that methods of garbage disposal have not kept pace with the marked improvements effected during recent years in other municipal sanitary services. While no effort has been made to obtain such information, it seems safe to assume that nearly all, if not all, of the cities utilizing the hog-feeding method of garbage disposal have

sewage and water systems sufficiently adequate for the prevention of fecal-borne diseases. Many of them have food-inspection services and probably most of them have milk ordinances based on the standard ordinance of the United States Public Health Service or ordinances equivalent to that ordinance. Thus, most of these municipalities have probably provided adequate protection against most of the diseases spread through food or water; however, in the case of trichinosis they are not only failing to provide adequate safeguards but are contributing to the spread of infection.

"The persistence of such an outmoded method of garbage disposal is accounted for in part by the revenue which many cities derive from such refuse. Some municipalities receive a sizable amount of income from the sale of garbage. Others, which merely furnish the garbage gratis to hog feeders, while not profiting directly, are relieved of the expense of disposal. With the present burden of taxation, any method of refuse disposal which represents a saving to the municipality appeals alike to the city official and the taxpayer. The general application of any suitable method or methods for the sterilization and processing of garbage so that its value as an animal food might be safely conserved would help solve the present problem. However, the economic factor is not the factor of prime importance. With such things as the use of night soil as fertilizer, we have long since disregarded the economic factor in favor of benefits to community health.

"State and local health officials may well assume the leadership in remedying the present anomalous situation. Effort should be made to encourage disposal by methods which are accordant with accepted public health standards. Until facilities are available for sanitary methods of disposal, it would be desirable for cities to include in contracts for garbage removal and disposal provisions for adequate cooking of garbage before its consumption by swine. In those cities already employing sanitary methods of disposal but benefiting from garbage sold or furnished gratis to farmers and hog feeders, the public health aspects of the matter should be considered and effort made to curb such practices. . . . Under present conditions, it would appear that little can be accomplished in the way of controlling trichinosis so long as our cities and towns continue their substantial contributions to the spread of the disease and serve as flagrant examples for others to do likewise."

As an example of the magnitude of planning control measures aimed at the cooking of garbage intended to be fed to swine, the 1941 Report comments on "The Secaucus Situation" as follows:

"Just outside New York, in Secaucus, New Jersey, there are nearly 50 vast hog farms on which garbage collected from New York City and New Jersey is fed raw to hogs. The live or dressed hogs are then shipped into New York City and the metropolitan area, where in the form of pork products they reach the consumer's table.

"What can be done about this situation? The fact that the hog raisers are outside the jurisdiction of New York State complicates the problem.

"The City of New York forbids any person to remove, dispose of, convey, or transport upon the streets or bridges or over the ferries in the City, manure, swill, garbage, etc., without having first obtained a permit from the Commissioner of Sanitation. Deputy Commissioner John B. Morton, of the New York City Sanitation Department, informs this Commission that as of September 26, 1940, there were 101 permits outstanding to vehicles engaged exclusively in the collection of swill (wet garbage, exclusive of ashes and rubbish). Most of these vehicles collect swill from restaurants and hotels, and, we believe, pay the producer of the swill for the privilege of taking it away.

"Of the 101 vehicles engaged in collecting swill, the residence of the operator on 97 of the permits is given as New Jersey; 3, New York City; 1, Rockland County. Deputy Commissioner Morton states: 'It is believed that the 97 vehicles, on the permits of which New Jersey is shown as the residence of the operator, are engaged in transporting the swill collected to New Jersey and that it is used preponderantly for hog feeding. We know definitely that none of

these 97 vehicles use our facilities for the disposal of the swill collected. We do not know how the other 4 vehicles dispose of the swill collected, but we do know that they do not use our facilities for its disposal. We believe that these 4 permit vehicles are disposing of the swill collected for hog feeding; we are certain that they are not using our facilities for its disposal, and to dispose of it otherwise in the City of New York is unlawful.'

"The New York City Sanitation Commission estimated that these 101 licensed trucks collect about 1,212 cubic yards of swill per day. If New York City were to undertake to collect and incinerate this garbage, it would cost the city about 30 cents per cubic yard for incineration and about 65 cents per cubic yard for collection, a total of 95 cents per cubic yard. Thus, if New York City were to ban collection of garbage for hog-feeding purposes, the cost of municipal collection and disposal of this garbage would amount to over $1,000 a day."

The treatment of garbage to destroy the trichina parasite when the garbage is to be fed to swine constitutes an important phase in the control of trichinosis in the United States. Laws and regulations requiring such treatment are of no avail in the absence of such regulatory control as is necessary to assure compliance. Following is quoted a United States Quarantine Regulation which by its first provision identifies trichinosis as a "Quarantinable Disease" and requires by its second provision that garbage be thoroughly cooked when it is intended to be used for feeding swine.

"AMENDMENT NO. 5 TO THE UNITED STATES INTERSTATE QUARANTINE REGULATIONS, PUBLIC HEALTH SERVICE

Federal Security Agency
Office of the Administrator
Washington, D. C.
October 11, 1941

In accordance with the provision of the Act of Congress approved February 15, 1893, the United States Interstate Quarantine Regulations are hereby amended to make Section 1 read as follows:

Quarantinable Diseases

1. For the purpose of interstate quarantine the following diseases shall be regarded as contagious and infectious diseases within the meaning of Section 3 of the Act approved February 15, 1893: Plague, cholera, smallpox, typhus fever, yellow fever, typhoid fever, paratyphoid, dysentery, pulmonary tuberculosis, leprosy, scarlet fever, diphtheria, measles, whooping cough, epidemic cerebrospinal meningitis, anterior poliomyelitis, Rocky Mountain spotted or tick fever, syphilis, gonorrhea, chancroid, anthrax, influenza, pneumonia, epidemic encephalitis, septic sore throat, rubella, chickenpox, psittacosis, and trichinosis.

Also as part of this amendment there shall be added to these Regulations Section 14½, as follows:

Use or Shipment of Garbage

14½. No person, firm, or corporation shall offer for shipment in interstate traffic, or shall accept for shipment or transport in interstate traffic any garbage intended to be used for feeding swine unless all particles of such garbage have been heated to a minimum temperature of 212°F., and held at that temperature at least thirty minutes in apparatus and by methods approved by the State or local health officer: Provided, That this requirement may be waived where such heat treatment of garbage intended for swine feeding is carried out at destination under State or local statutes, ordinances, or regulations.

PAUL V. MCNUTT,
Administrator"

As an example of a State requirement for the cooking of garbage intended to be fed swine, following is quoted an Act of the New York State Legislature:

"GARBAGE COOKING LAW
CHAPTER 214, LAWS OF 1942

An Act to amend the general municipal law, in relation to disposal and treatment of garbage.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. Chapter twenty-nine of the laws of nineteen hundred nine, entitled "An act in relation to municipal corporations, constituting chapter twenty-four of the consolidated laws, is hereby amended by inserting therein a new section, to be section one hundred and thirty-five-d, to read as follows:

§ 135-d. Disposal and treatment of garbage. Any contract made or any permit issued by a municipal corporation or any public or private institution therein for the sale, collection or disposal of garbage shall require that the garbage be boiled for not less than one-half hour before it shall be used for the purpose of feeding pigs, hogs or swine.

§ 2. This act shall take effect immediately."

The foregoing represent Federal and State requirements which are only as effective as their enforcement.

Microscopic Examination.—Microscopic examination of samples of pork muscle tissue taken at the time meat inspection post-mortem examination is made of a swine carcass has been a recognized method of trichinosis control in Europe for many years. Early Federal meat inspection procedures in the United States which had their beginning with the Act of Congress approved August 30, 1890, were patterned after European practices, principally those followed in Germany. By regulation of the United States Department of Agriculture, dated March 25, 1891, microscopic examination of samples of pork muscle tissue were required to be made, and by regulation dated June 14, 1895, such examinations were limited to pork intended for export. The following paragraph is quoted from the regulation of June 14, 1895:

"19. The microscopic inspection of pork intended for export to countries requiring such inspection shall be conducted as follows: When the slaughtered hog is passed into the cooling room of said establishment, the inspector in charge, or his assistants, will take from each carcass three samples of muscle, one from the 'pillar of the diaphragm,' one from the psoas muscle, and the other from the inner aspect of the shoulder, and said samples will be put in a self-locking tin box and a numbered tag will be placed upon the carcass from which said samples have been taken, and a duplicate of said tag will be placed in the box with said samples. The boxes containing the samples from the hogs in the cooling room, so tagged, will be taken to the microscopist for such establishment, who shall thereupon cause a microscopic examination of the contents of each box containing samples to be made, and shall furnish a written report to the inspector, giving the result of said microscopic examination, together with the numbers of all carcasses from which samples have been examined."

These microscopic examinations were discontinued in 1906. Since that time there have been no microscopic examinations made in the United States as a routine meat inspection procedure in connection with post-mortem examinations made incident to the preparation of pork for human food.

The statement of policy made by the United States Department of Agriculture in connection with the decision of its Federal Meat Inspection Service to discontinue microscopic examinations appears in the Annual Report of the Bureau of Animal Industry for 1906 as follows:

"PORK NOT EXAMINED MICROSCOPICALLY FOR TRICHINÆ

While the Federal meat inspection in this country is as thorough as a comprehensive law, stringent regulations, and a liberal appropriation of money can make it, and the consumer of meats bearing the stamp "U. S. Inspected and Passed" may in general have the comfortable assurance that he is buying and eating products from healthy animals prepared under clean and sanitary conditions and the danger of contracting disease from eating these meats is practically eliminated, yet the fact should not be overlooked that there is one disease against which the meat inspection legend does not pretend to be a safeguard. For the detection of most of the diseases affecting meat the human eye needs no assistance. The disease called trichinosis, however, to which hogs are subject, is caused by a parasite so small that the microscope must be employed to detect it. Thorough curing or thorough cooking of the meat kills this parasite. It seems, however, that some European peoples have a habit of eating raw or half-raw pork, and consequently they have suffered from this disease. Very elaborate measures have been taken in some countries to do away with or to lessen the danger. In Germany, for instance, there is an army of inspectors who use the microscope to detect these parasites in pork. These countries some years ago forbade the importation of American pork products unless they had been microscopically inspected. To meet this requirement the Bureau instituted several years ago a system of microscopic inspection of pork intended for shipment to such countries. No microscopic inspection of pork intended for home consumption, however, has ever been made or even contemplated. The Department takes the ground that from the nature of the disease an examination of certain parts of a hog carcass can only minimize and not eliminate the danger.

"The parasites, it is true, are usually found, if found at all, in certain parts, as the pillar of the diphragm, the psoas muscle, the inner aspect of the shoulder or the base of the tongue. Not finding them in these parts by the usual methods, it may be assumed to be probable that they do not exist in the remainder of the carcass. This is, however, only a probability, as they may exist, and even to such an extent as to produce disease if the flesh is eaten raw. Many cases are on record where twenty, even thirty, examinations were made before trichinæ were found; and out of 6,329 cases of trichinosis in Germany, between 1881 and 1898, a careful inquiry traced 2,042 cases (over 32 per cent) to meat which had been microscopically examined and passed as free from trichinæ. In view of these facts the Department has regarded it as utterly impracticable to inspect hog carcasses for this disease. It has further taken the view that such inspection which as formerly carried on for exported products would cost about $3,700,000 a year if all hogs killed at inspected houses were so examined would do more harm than good. It would create in the minds of the consumers a feeling of false security, which might lead them to omit the only sure means of escaping danger, namely, to refrain from eating uncooked or uncured pork; and it would thus defeat its very purpose and render the great trouble and expense worse than useless.

"Not only has the Department not inspected for trichinæ the pork consumed at home, but it has abandoned recently such inspection of pork products going abroad. It was found that even after our elaborate examination some foreign countries, although requiring our inspection, paid no attention to our certificates, and conducted an examination of their own, on the result of which depended the admission of the products. On the ground, then, that our examination was superfluous, the Department stopped it. Of the principal countries

formerly requiring certificates of this examination Italy and France already have agreed to admit our products without them, and upon the certificate simply of the regular inspection under the present law. It is hoped that other countries will take similar action."

During the public hearings held in 1941 by the New York State Trichinosis Commission considerable attention was given to microscopic examination for trichinæ as a control measure. The following is quoted from the Commission's 1941 Report:

Control Through Microscopic Inspection

Chairman Thomas C. Desmond, at a public hearing held by this Commission, said:

"When Germany and France banned the importation of American pork toward the close of the 1800's, our federal government required that pork designed for export be subjected to microscopic inspection. A little more than one out of fifty hogs were found to be infected. With the passage of the federal meat inspection act in 1906, microscopic inspection was abandoned, and in its place there was substituted the present regulation requiring the processing of pork products customarily eaten without cooking. Microscopic inspection is in force in Germany today. But most authorities seem to agree that this method is impractical, too costly, and would give our people a false sense of security."

Dr. Maurice C. Hall, in 1938, wrote:

"The meat-inspection statistics of Germany give convincing evidence that microscopic inspection of pork leads in the direction of eradication of both human and porcine trichinosis in Germany, since the incidence of both have fallen to exceedingly low figures during the past half century. That inspection has fitted into the more leisurely slaughter-house procedures of Germany, and although it now costs many thousands of dollars to find one trichinous pig, that alone is evidence that it is accomplishing its mission in the control of trichinosis. Under the high-speed procedure of American packing plants, microscopic inspection for trichinæ would require the training and use of a regiment of inspectors at a cost exceeding our present total cost for meat inspection. It would be especially expensive and difficult if anything approximating the present speed of plants were maintained, and in all probability it would slow down those procedures. If unaccompanied by changes in our methods of swine production, it would mean enormous expenditures for perhaps fifty or one-hundred years. Unless it were nationwide, which would call for legislation by all of the States, it would unquestionably be dangerous, since its application by the federal government to interstate shipments alone would give a false sense of security in the consumption of a pork supply that was a mixture of inspected and uninspected pork as marketed and served. So long as there is a simple and inexpensive control measure in sight, this alternative may be regarded as one of those last painful measures which should be taken only under stress of necessity."

Speaking at the public hearing conducted by this Commission, Dr. Benjamin Schwartz discussed meat inspection aspects of trichinosis. A portion of his discussion concerned microscopic inspection of pork products. He said:

"Following the discoveries made in Germany in 1860 regarding the mode of transmission of trichinæ through the consumption of raw pork and the demonstration, at about the same time, that these parasites are injurious to human health, the medical profession and, in fact, the general population of that country became trichina conscious and alarmed over the possibility of acquiring from pork a serious and sometimes a fatal disease. Since the people of northern Germany commonly ate raw pork it became quite evident to the sanitary authorities of that country that serious consequences were apt to follow the indulgence in this habit.

"On the heels of the discoveries concerning trichinosis, serious outbreaks of this disease in small towns in Germany actually came to light. As a result of these and other outbreaks of trichinosis the German government instituted a system of microscopic inspection of pork which, so far as is known has survived until the present time, and has been imitated by other, but not all, countries on the European continent. The establishment of microscopic inspection in any country is a frank recognition by public health authorities that they have to reckon with a custom, deeply rooted in the general population, that regulates the cooking of pork by the palate rather than by the thermometer.

"That the United States at one time had a microscopic inspection of pork for trichinæ appears to be well known, owing to the numerous articles on trichinosis that have appeared in newspapers and magazines in recent years. What is not so well known, perhaps, is the fact that the microscopic inspection of pork for trichinæ that was practiced in this country under Federal meat inspection for a period of fifteen years (1891 to 1906) did not apply to all hogs slaughtered in officially inspected establishments. Actually, it applied only to pork intended for export to certain countries in Europe which required this inspection. The admittance of pork from the United States to certain European countries was prohibited unless the shipments were accompanied by certificates setting forth the facts that the pork had been inspected microscopically and found free from trichinæ. In short, the motives that led to microscopic inspection of samples of pork from each hog designed for the export trade were economic rather than hygienic. This inspection did not apply at any time to the total hog slaughter that was subject to Federal inspection.

"Although trichina inspection with the microscope, as practiced in this country, was done in the accepted manner by microscopists who were under constant professional supervision, experience with this inspection was such as to warrant the belief that even when carried out conscientiously, such inspection does not and cannot offer an absolute guarantee that any carcass passed as free from trichinæ, is really uninfected. According to statement published by German meat inspection experts, samples of pork from this country certified as being free from trichinæ were found, in some cases, to be infected after being reinspected at their destination. This is not surprising, considering the fact that only about 3 small samples, each about the size of an oat grain, were examined, in accordance with the usual custom, following their compression between glass slides. Since trichinæ are not uniformly distributed throughout the muscles, it is quite possible to miss these parasites in particular samples that happen to be taken for examination. It must be admitted that this possibility diminishes in proportion to the intensity of the infection, the parasites in lightly or moderately infected carcasses being more apt to escape detection than those in carcasses that are heavily infected. That the American system of microscopic inspection of pork was not inferior to that practiced elsewhere was shown as follows: An investigation conducted by the Bureau of Animal Industry of the U. S. Department of Agriculture in Germany showed that out of a total of over 6,000 cases of human trichinosis that occurred in that country in the latter part of the nineteenth century about 33 per cent were caused by pork that had been examined microscopically by German inspectors and certified by them as being free from trichinæ.

"Aside from the inherent imperfection of microscopic inspection as a prophlyaxis against trichinosis, other objections, equally serious, have been marshalled against this scheme of prevention. It is reasonable to assume that knowledge of the existence of microscopic inspection would tend to encourage the consumption of raw pork and thereby undo much of the good that the inspection might accomplish by eliminating from the channels of trade carcasses showing marked infection. This knowledge would tend to create in the minds of persons who are fond of raw pork a false sense of security and thereby defeat in a measure the very purpose for which the inspection was intended.

"Another, and perhaps, more serious objection to microscopic inspection in this country arises from the following circumstances. Federal inspection of food animals in the United States is limited to plants that engage in interstate

and/or foreign commerce. Plants not engaging in such enterprises do not come under the provisions of the meat inspection act of Congress and are subject only to state or municipal inspection, or are entirely without inspection. Moreover, slaughter done on the farm is exempt from federal and all other inspection. Since few states and not a great many municipalities have a rigid system of meat inspection, it cannot be supposed that all swine carcasses slaughtered in this country would be subjected to microscopic inspection even though such inspection were maintained by the federal government. Very few consumers would take the trouble to differentiate between pork inspected microscopically under Government or equally competent supervision and pork not so inspected. The confusion that would result from this state of affairs would nullify, at least in part, much of the good that would result from microscopic inspection.

"Aside from the objections already cited, there still remains to be considered the rather serious question of the cost of microscopic inspection. Approximately 40,000,000 hogs are slaughtered under federal inspection annually, this representing about 60 per cent of the total hog slaughter in the country as a whole. It is safe to state that the cost of microscopic inspection would average about 25 cents per hog, so that the annual cost of inspecting for trichinæ under Government supervision would amount to about $10,000,000. Considering the fact that this sum is almost twice that of the present total cost of all federal meat inspection, the drain on the public treasury for an inspection which, at best, is only partially effective, would hardly appear to be warranted."

Treatment of Pork Products Customarily Eaten Without Cooking.—The Federal Meat Inspection Service faced with the problem of working out a program of trichina control within the area of its responsibility requires that all pork products which are customarily eaten without cooking that are prepared under its supervision be treated by one of the methods prescribed by its regulation to destroy any live trichina which may be present in the product. The Federal meat inspection regulations which outline in detail these requirements appear on page 388 of the Appendix. Under the heading "Processing of Pork" the New York State Trichinosis Commission in its 1941 report considers fully the position of the United States Department of Agriculture with respect to its requirement for destruction of live trichina in pork products customarily eaten without cooking.

"A regulation of the United States Department of Agriculture states: 'Inasmuch as it cannot certainly be determined by any present known method of inspection, whether the muscle tissues of pork contain trichinæ, and inasmuch as live trichinæ are dangerous to health, no article of a kind prepared customarily to be eaten without cooking shall contain any muscle tissue of pork unless the pork has been subjected to a temperature sufficient to destroy all live trichinæ, or other treatment prescribed by the chief of the bureau.'

"It should be emphasized that this requirement does not affect meat products made and sold within a single state, and that this requirement does not affect pork products customarily cooked by the consumer. It should also be stressed that the legend 'U. S. Inspected and Passed' on fresh pork or on ordinary varieties of cured pork which the consumer customarily cooks does not mean that the product so marked is free from *Trichinella spiralis;* it merely means that the meat has been inspected in the same way that all meat is inspected in establishments operating under federal inspection.

"Dr. Benjamin Schwartz, speaking at the November 28, 1940, public hearing held by this Commission said: 'In the absence of any known practical inspection to determine whether the muscle tissue of pork contains trichinæ, no guarantee of any kind as regards the freedom from these parasites can be given in the case of fresh pork in all forms. This includes not only the various cuts

of fresh pork, but also fresh sausage containing pork muscle tissue, and such cured or smoked pork as ordinary hams, shoulders, shoulder picnics, bacon, and jowls, all of which are considered as articles which are or should be well cooked in the home and elsewhere. Under federal meat inspection, all products containing pork muscle tissue to be sold as cooked products or as cured products that are fit for consumption without cooking, are treated by methods which are known to be destructive to the vitality of trichinæ. In this category are included bologna-style sausage; frankfurt-style sausage; Vienna-style sausage; smoked pork sausage; chopped, cured meat rolls; all forms of summer and dry sausage; cured, boneless pork loin; fresh, boneless loin in casings; boneless, back bacon; roast, baked, cooked or boiled ham, shoulder or shoulder picnic; Italian-style ham; and other products commonly intended for consumption without cooking.

"Dr. Schwartz also said in a recent report:

'The treatments prescribed by the Chief of the Federal Bureau of Animal Industry for all meat food products containing pork muscle tissue that are prepared to be eaten customarily without cooking, are (1) heating, (2) special refrigeration, and (3) special processing, these procedures having been found by extensive, painstaking scientific investigations to be deleterious to the life of trichinæ. Under the prescribed heating it is required that all meat food products of kinds mentioned must be so heated that they will attain in all parts a temperature of not less than 137° F. The required refrigeration involves the subjection of pork or of articles containing pork muscle tissue to a temperature of not higher than 5° F. for a continuous period of not less than twenty days, provided the meat or articles, not exceeding 6 inches in diameter, are hung singly up or packed in boxes not exceeding 6 inches in thickness. In the case of pork or products packed in barrels or tierces, the period of refrigeration is extended to thirty days.

'Owing to more or less recent improvements in refrigeration, it has been determined that meat packing establishments operating under federal inspection commonly maintain their freezers used for treating pork to destroy the vitality of trichinæ at temperatures much lower than 5° F. With this in mind, investigations were conducted recently by the Bureau of Animal Industry to determine the extent to which the required holding period of pork and products could be decreased if the temperature of the freezer is maintained at 10° F. The results of these investigations showed that when pork is packed in boxes not exceeding 6 inches in thickness the required holding period in freezers maintained at −10° F. could be reduced to ten days and that when the meat or products are packed in tierces, the period of refrigeration need not be extended beyond twenty days. Tests were made also with trichinous pork kept in freezers maintained at a temperature of −20° F. As would naturally be expected, it was determined that the required holding period at this low temperature for pork packed in boxes not exceeding 6 inches in thickness could be still further reduced, actually to six days, and for pork packed in tierces the period could be reduced to twelve days. These results show, therefore, continued progress in investigations of and ultimate application of practical methods designed to destroy the vitality of trichinæ in pork destined to be converted into products of kinds customarily eaten by the consumer without cooking.'

"Dr. J. R. Mohler, Chief of the United States Bureau of Animal Industry, informed this Commission as follows:

'The recent regulations concerning the refrigeration of pork at −10° F. and −20° F. are based on 205 distinct tests, each test having been conducted in a large meat packing establishment in Chicago. The tests were conducted as follows: Trichina-infected pork, together with other pork furnished by a large meat packing company, was packed in tierces, 27 inches in diameter, and in boxes not exceeding 6 inches in diameter. The boxes and tierces were held at temperatures of −10° F. and −20° F., respectively, for specified periods. At the end of the holding period, the trichinous meat, which was in the center of the box or tierce, wrapped in muslin, was removed, allowed to thaw, and a small

portion of it was digested in artificial digestive fluid in an incubator; the remaining meat, or such portions of it as necessary, was fed to a series of several rats, these animals being kept for at least thirty days before being slaughtered. The sediment of the digestive fluid was carefully examined for trichinæ and various tests were made to determine whether the trichinæ recovered were dead or alive. The diaphragm of each rat was examined for trichinæ and if no worms were found the entire carcass, which was skinned and eviscerated, was digested in artificial gastric juice and the sediment was examined for trichinæ.

'In experiments involving refrigeration of trichinous pork in tierces at a temperature of $-10°$ F., 25 distinct tests were conducted and in no instance were trichinæ found in the muscles of rats to which this frozen meat had been fed; in experiments in which the trichinous meat was packed in boxes, 79 tests were conducted with consistently negative results.

'In experiments involving a temperature of $-20°$ F., 25 tests were conducted with trichinous pork packed in tierces and 76 tests were conducted with trichinous pork packed in boxes. The results of this series were negative throughout.'"

Refrigeration of Pork.—With the knowledge that low temperatures will destroy the live larvæ of trichinæ in pork muscle tissue, consideration has been given from time to time to the probability of having all pork produced in the United States treated by freezing to make it safe against trichina. Interested parties have been encouraged to believe that such a method of control might be practicable in view of the availability of refrigeration in connection with meat packing and meat distribution facilities.

The Committee on Public Health Relations of the New York Academy of Medicine held hearings and examined into the question generally of control of trichinosis with emphasis particularly on the probability of treating the entire pork supply of the United States with low temperatures to destroy trichinæ. The Committee's report is published in the April 9, 1948, issue of the Public Health Reports of the United States Public Health Service. This report contains interesting summations concerning the incidence of trichinosis and methods for its control. The following is quoted from that part which evaluates the use of low temperatures for the treatment of all pork produced in the United States.

"PORK PROCESSING, WITH SPECIAL REFERENCE TO FREEZING

Gould[5] advocated Federal, State, and local regulations requiring that all pork be processed. He expressed the opinion that if all pork were processed, trichniosis would be quickly eliminated from hogs, since they acquire the infection principally from eating pork scraps in garbage.

A less sweeping proposal would extend the requirements for processing to cover products which usually are cooked, but are sometimes eaten raw or inadequately cooked. A representative of the New York City Department of Health stated that in 888 of 1,075 cases of trichinosis reported in New York City from 1934 to 1944, the histories indicated that the patients had eaten products of this kind. For these products no processing is now required by the regulations of the United States Department of Agriculture. The Department, however, requires processing of all other types of pork products; these must be heated to a temperature not lower than 137° F., cured by salting and smoking, or frozen. In the slow freezing process now recommended by the Federal regulations, pork products less than 6 inches thick are held at 5° F. for twenty days. Products in pieces more than 6 and less than 27 inches thick must be held for thirty days. Shorter periods are permitted if lower temperatures are applied;

[5] Gould, S. E.: Bull. N. Y. Acad. Med., *21*, 616, 1945; J. A. M. A., *129*, 1251, 1945.

that is, ten days for small pieces and twenty days for those more than 6 inches thick at −10 °F., and six to twelve days, respectively, for the two sizes at −20 °F.

In New York City there are regulations requiring that unless a processor uses pork previously frozen, he must heat thoroughly before selling any pork product customarily eaten uncooked. In a report of 84 cases of trichinosis in the city in 1945, Shookhoff and his associates[6] recorded that the pork used in the meats that caused the outbreak had not been frozen as recommended; it was said that refrigerating companies licensed to do this work had found it more profitable to use their facilities for other purposes, and consequently the practice of freezing pork had been discontinued.

Modern quick-freezing methods have not been adapted for use in the processing of pork. Augustine[7] experimented in 1933 with raw pork loin roasts in which infected guinea-pig muscle had been inserted. Then the infected cuts were brought rapidly to low temperatures varying from −18.1° to −34.6° C. (Note: −17.8° C. is equivalent to 0° F.). It was found that the parasites were not injured until the temperature reached −27.6° C. Complete destruction was attained, however, when trichinous material was lowered to −18° C. and held at that point for twenty-four hours. Dr. Augustine presented these figures before the subcommittee.

A report of a similar investigation was published in 1934 by Blair and Lang.[8] These investigators used rat muscle in order to determine whether a different species of test animal would produce different results. Resistances to freezing were greater than those observed by Augustine. Blair and Lang found that larvæ encysted in rat muscle could be killed by rapidly lowering the temperature to −35° C., but not until the muscle had been held at the lower temperature for two hours. They were of the opinion that it would be impracticable to use this method commercially because of the slow rate at which large volumes of pork and pork products cool. After experiments with pork roasts, the investigators concluded that commercial quantities of pork rapidly frozen to −17.8° C. must be stored at the same temperature for more than forty-eight hours. When ground meat was frozen rapidly, encysted trichinal larvæ were killed in a few minutes. They concluded that additional investigation on the efficacy of quick freezing of heavily infected pork was imperative. They also suggested that studies of the effect of the age of the larvæ and of the relation between resistances to cold of different species of animals would add value to comparisons of methods.

The committee consulted the American Society of Refrigerating Engineers for information concerning developments in freezing techniques and the costs involved. That society's Technical Committee A-3 on Meat Packing, in a report prepared especially for the Committee on Public Health Relations, expressed the opinion that the freezing of all pork to destroy trichinæ is impracticable under present conditions and that if freezing were practicable it would materially increase the cost of pork to the consumer. Members of the engineers' committee are as follows: J. P. McShane, Swift and Co,. Chicago, chairman; H. K. Gillman, Tobin Packing Co., Fort Dodge, Iowa; T. A. D. Jones, Kingan & Co., Indianapolis; F. P. Neff, Tupman and Thurlow, Chicago; Starr Parker, H. H. Meyer Packing Co., Cincinnati; R. W. Ransom, John Morrell and Co., Ottumwa, Iowa; H. H. Shulman, Hammond Standish & Co., Detroit; K. E. Wolcott, Wilson & Co., Chicago, and J. S. Bartley, Rath Packing Co., Waterloo, Iowa.

The engineers estimated that it would require the equivalent of all the present freezer capacity in the United States to process all the pork produced, if the slow freezing now recommended by the Department of Agriculture were employed. If quick freezing methods should be developed, less space would be required, but more insulation and more refrigerating compressor displace-

[6] Shookhoff, H. B., Birnkrant, W. B., and Greenberg, M.: Am. J. Pub. Health, *36*, 1403, 1946.

[7] Augustine, D. L.: Am. J. Hyg., *17*, 697, 1933.

[8] Blair, J. B., and Lang, O. W.: J. Infect. Dis., *55*, 95, 1934.

ment capacity would be necessary and the operating costs would then be higher. Moreover, other new facilities would be required in packing plants. Among such facilities were mentioned: Refrigerated space for wrapping and packaging the pork before freezing; storage space for boxes, cartons and other supplies, and new 'thaw rooms' with controlled temperature, humidity and circulation of air for defrosting the pork to be cured. The engineers claim that to provide additional space it would be necessary to make extensive changes in plants or to utilize new public cold storage space.

Increased costs, which would be borne by the consumer, would arise partly from the acquisition of the new equipment and the extra space needed for large-scale refrigeration, and partly from the extra handling entailed in the freezing process. No actual estimates of the cost were submitted.

Certain other objections to freezing were advanced by the engineers: (1) The investment in the product and in special supplies would add to the risk of doing business; (2) the 'dripping' and color of frozen pork make it unattractive; (3) the necessity for keeping the product frozen until it was ready for cooking would further complicate the handling and would necessitate special equipment in retail stores; and (4) it would be impossible to supervise the freezing of pork from hogs slaughtered on farms. The opinion was also expressed that regulations requiring the freezing of all pork might engender false feelings of security, since a small proportion from establishments which were not under effective inspection might still harbor trichinæ. Some of the difficulties cited are probably exaggerated. Many retailers now have installed freezers in their stores for other frozen products; the danger from lack of supervision of individual farms would not be increased by a requirement for freezing. The matter of chief importance is the question of increased cost for a food which is as wholesome and popular as pork is.

A proposal to refrigerate all pork was advanced several years ago, but packers at that time declined to consider the idea on the ground that their facilities were inadequate. In the opinion of one observer, cooperation on the part of the packers with Federal, State, or local authorities on the control of trichinosis has never been forthcoming; it was his impression that the main attention of the trade had been directed to lessening publicity concerning the disease, because it was feared that publication of facts relating to it would react adversely on the industry.

In the recent statement on refrigeration, Gould commented that 'the main costs connected with this method of control of trichinosis are the costs of apparatus, such as refrigerating units and storage space. These expenses are initial ones and similar initial expenses would be found necessary in any other method. The operation or maintenance of the method, however, would require relatively little personnel as compared with microscopic inspection, and the method of processing would, therefore, be much cheaper. In the last analysis the cost of this method would be borne by the consumer. The consumer would in fact be glad to assume this extra cost if he could have the assurance that he was receiving meat that was free from living trichinæ.'

In the opinion of Ober,[9] the growing popularity of deep-freeze cabinets in individual homes may be an important factor in encouraging the adoption of refrigeration as a method of destroying trichinæ in pork. If the method was adopted generally, a decrease in trichinosis could be anticipated."

Diagnosing Trichinosis in Swine.—Another method of control that has been considered is one which would identify at the time of slaughter those swine which are infected with trichina. The impracticability of testing large numbers of swine as they are brought into packing houses has been fully appreciated. Nevertheless, diagnostic agents and their use have been studied to determine their reliability.

Investigations conducted in 1939 by L. A. Spindler and S. X. Cross of

[9] Ober, R. E.: New England J. Med., *235*, 839, 1942.

the United States Bureau of Animal Industry examined into the efficacy of intracutaneous tests for the detection of trichina infections both experimentally and naturally acquired by swine. The following is quoted from the discussion contained in the report of these investigations:

> "Findings herein reported indicate that the intracutaneous tests used for the detection of trichina infections in swine as applied under conditions of these investigations failed to show that the test can be relied upon to detect all trichina infected swine. Complete failure of various antigens to produce reactions in 29.8 per cent (average) of tests involving infected animals is of utmost importance from a practical standpoint. It was observed that a number of these non-reacting animals were heavily infected with trichinæ. . . . as stated previously, results of tests herein reported indicate that the intracutaneous test as applied for the detection of trichina infections in swine is lacking in specificity and cannot be relied upon to detect all infected animals. If an intracutaneous test for the detection of trichina infections in swine is to be used on a practical basis, it should detect all infected animals irrespective of the age and color or the age and degree of infection. Furthermore, reactions must be of such strength, distinctness, and clarity that they will under no circumstances be masked by wrinkles or pigmented areas in the skin, or be confused with bruises, abrasions, or with any of the other abnormal conditions frequently found on the skin of swine coming to slaughter in abattoirs. In addition, the reactions must be so distinct and clear-cut that they can be readily observed by trained inspectors."

Again in 1940 Spindler and Cross joined by J. L. Avery, also of the United States Bureau of Animal Industry, conducted further investigations concerning intracutaneous tests for the detection of trichina infections in swine. The following is quoted from their report:

> "The results of test herein reported are in agreement with those previously published (Splindler and Cross in 1939). Although antigens made by a variety of ways, including chemical fractions of trichina larvæ were tested, none gave reliable results when applied to swine in slaughterhouses. In 11,711 tests on swine at abattoirs, the status of animals as regards trichina infection was correctly detected in approximately 63 per cent of the tests."

Education.—Since trichinosis is contracted by man almost entirely by the ingestion of viable trichina larvæ in pork, the destruction of these larvæ before the pork is consumed constitutes a complete safeguard. The method of destruction most readily available to the consumer is cooking. Cooking that raises the temperature of the pork product to at least 137° F. throughout is sufficient to make the product safe against trichina.

The control method employed by the United States Department of Agriculture in its supervision over federally inspected meat packing plants contemplates classifying all pork and pork products prepared in those plants into two categories. One category includes those pork products which are classed as customarily eaten without cooking, such as frankfurter, bologna, and many others which are listed in the regulations on page 388 of the Appendix. The Federal Meat Inspection Service requires that these products be treated by one of the prescribed methods (page 388 of the Appendix) to destroy possible live trichina. The other class of pork products is constituted of those customarily cooked by the consumer before eating and includes such products as pork chops and raw pork generally, bacon, and the like. The inspection has taken no precaution

to eliminate or destroy any viable trichina larvae that may be present in the muscle tissue of these raw pork products. Thorough cooking of such pork products by the consumer before they are eaten protects the consumer against infection.

Education and publicity which emphasize the necessity for cooking pork and its products thoroughly are an important adjunct to trichinosis control in the United States.

The importance of education is recognized in the 1941 Report of the New York State Trichinosis Commission from which the following is quoted:

> "CONTROL THROUGH EDUCATION
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> Dr. Willard H. Wright has stated: 'We might inaugurate an intensive campaign of publicity and thus sound a general alarm, warning the public that one in every six persons is probably infested with trichinae, that trichinosis is rife, that pork is dangerous and that illness lurks in this important item in the diet of most of our people. Considering that various agencies have for years been utilizing nearly every available means to warn the public to cook pork well, and that these warnings have been followed by no decline in the incidence of the parasite, it does not appear that a continuation or extension of such measures will be of any more value than formerly. It seems that the use of widespread publicity would not only be a futile gesture toward the control of trichinosis but might work incalculable harm to the swine grower and the meat-packing industry. It is evident that a certain portion of the American public prefers its pork rare, just as it prefers its beef rare, and it will probably continue to indulge in its tastes regardless of warnings to the contrary.'
>
> "The immediate aim of education in the field of trichinosis is to impress the consumer with the need of eating pork thoroughly cooked. But, as Senator Desmond pointed out at the public hearing of this Commission: 'We can no longer make the attack on this pork disease a matter of individual option and private responsibility alone.'
>
> "For years, government officials have been urging housewives and others to cook pork thoroughly. Regardless of what control measures are adopted, it seems clear that this educational campaign must be continued and expanded. An extensive publicity campaign will undoubtedly be helpful in preventing trichinosis, but it is far from being the final solution to the problem.
>
> "This Commission has engaged in considerable educational work, stressing not only the fact that pork should be well cooked, but also that well-cooked pork is a healthful, nourishing food. Daily and weekly newspapers, the press associations, and magazines have cooperated in informing the public as to how trichinosis may be prevented.
>
> "It has been suggested that a coordinated, intensive education drive by our State Health Department, Department of Agriculture and Markets, and Education Department might well be launched. Every medium of education might be used. The United States Department of Agriculture has printed some pamphlets and posters urging thorough cooking of pork. The American Meat Institute has done some work in this field. But it is obvious that much more remains to be accomplished. The goal of a trichinosis educational campaign should be to impress each consumer with the need for eating only pork which is thoroughly cooked."

For many years the United States Department of Agriculture has disseminated information concerning trichinosis, and as part of its meat inspection program it has distributed a great deal of printed material emphasizing the importance of cooking pork products thoroughly before eating. One of the Department's folders is reprinted on page 331 of the Appendix.

Courts.—The rights of the individual consumer with respect to his purchase of trichina infected pork and the liabilities of the seller of such pork are best understood by consulting cases on the subject decided by courts in the United States. The attitude of the courts not only has significance with respect to a particular transaction involving rights and liabilities of the parties to a sale of trichinous pork, but it is inevitable that the position taken by the courts will influence the attitude of the American meat packer toward trichinosis controls.

The following cases are listed chronologically. They are of necessity selected cases and represent what appears to be a trend in the decisions by courts from a strict ruling of absolute liability on the part of the seller to a more liberal attitude in his favor. These cases should not be considered as representing the law of the land. An understanding of the rights of any invididual in connection with a case involving trichinosis can be had only by a careful study of the legislation and the decided cases in the particular jurisdiction as they relate to the facts of the particular case.

Rinaldi *v.* Mohican Co.

Decided by the Court of Appeals of New York December 10, 1918

Mrs. Rinaldi contracted trichinosis from eating of a pork loin purchased by her from the Mohican Company stores. The lower court decided the case in favor of Mrs. Rinaldi and the Mohican Company stores appealed to the higher court for a review.

In upholding the decision of the lower court in favor of Mrs. Rinaldi, the court of appeals pointed out that the case was not tried on any theory of negligence or fraud but upon that of implied warranty. In deciding the case in favor of Mrs. Rinaldi, the Court of Appeals held that "the mere purchase by a consumer from a retail dealer in foods of an article ordinarily used for human consumption does, by implication, make known to the vendor the purpose for which the article is required. . . . we think further that such a purchase where the buyer may assume that the seller has the opportunity to examine the article sold, unexplained, is also conclusive evidence of reliance on the seller's skill or judgment. . . . Therefore, in case of a purchase of a portion of unwholesome meat from a market after section 96 (Personal Property Law) went into effect, where all that appears is the ordinary transaction between dealer and customer, a charge to the jury that on every sale of food by a dealer for immediate human consumption there is an implied warranty of its wholesomeness, while inaccurate, is harmless. . . . There is no question but what such an action for damages caused by the breach of the implied warranty, with regard to food may be maintained, at least by him to whom the warranty is made. Whether in favor of others we do not determine."

Cheli *v.* Cudahy Bros. Company

Decided by the Supreme Court of Michigan June 4, 1934

Cheli's wife contracted trichinosis as a result of eating uncooked sausage which she prepared from fresh pork butts purchased by her from a retail meat dealer who in turn obtained them from Cudahy Bros. The lower court decided in favor of Cheli, and Cudahy Bros. petitioned the Supreme Court of Michigan for review.

In reversing the lower court and deciding the case in favor of the defendant Cudahy Bros. Company, the Supreme Court considered both counts contained in the declaration, namely, negligence and breach of implied warranty on the part of Cudahy Bros.

In considering the contention of Cheli that the violation of the State Statute which prohibits the sale of adulterated foods is negligence *per se*, the court ruled as follows: "To give the statute such force in this case would in effect impose upon the manufacturer the liability of an insurer regardless of the usual nature of the use to which its product is put . . . . we cannot hold that the legislature intended to impose upon the producer the absolute civil responsibility of an insurer in cases where every reasonable means designed to guarantee the safety of food for normal use has been employed. . . . It seems well established by evidence that the danger to the public is reduced to a minimum if the meat (pork) is thoroughly cooked. The ultimate consumer, however, demands that fresh pork be offered for sale."

With reference to the allegation of Cheli that Cudahy Bros. Company is guilty of a breach of warranty the court ruled as follows: "Nor is there any showing that an implied warranty or condition as to the quality or fitness of raw pork as food in an uncooked condition is annexed to the sale by the usage of trade. . . . It seems to show logically that it is unfair to impose the liability of an insurer upon the meat packer through the implication of a warranty that pork is fit for human consumption in a raw state. This is especially true in view of the fact that the danger of infection can be reduced almost to the vanishing point by ordinary cooking methods. Fresh pork is not ordinarily intended to be eaten raw. The warranty should be applied only to food used in the usual rather than in the unusual and improper manner."

ZORGER *v.* HILLMAN'S

DECIDED BY THE APPELLATE COURT OF ILLINOIS, FIRST DIVISION, FIRST DISTRICT NOVEMBER 30, 1936

Zorger claims to have bought a pork loin at Hillman's store. The loin was cut into chops which were fried and eaten by Zorger. Zorger claimed to have contracted trichinosis from eating the pork chops. The lower court decided in favor of Hillman's, and Zorger appealed to the higher court for a review of the case.

In upholding the lower court's decision in favor of Hillman's, the following statement was made as it has a bearing on the implied warranty of fitness for food attaching to a sale of pork: "Plaintiff (Zorger) says that the Criminal Code, Chapter 38, Section 7 . . . forbids selling any flesh of any diseased animal and that this has been construed (in the courts of Illinois) as forbidding the sale of pork containing trichina regardless of the fact that ordinary cooking will make it harmless. The cited case does not so hold but in apt language cites 'that the article sold is sound and fit for the use for which it is purchased.' The use for which pork is purchased is to eat it cooked, not raw. A number of cases in other jurisdictions involved the scientific facts relating to trichinæ and these decisions support our view that pork chops are not sold to be eaten raw and that the wholesomeness required by our Pure Food Statute means that pork is fit for food when properly cooked."

FEINSTEIN *et al. v.* DANIEL REEVES, INC., *et al.*

DECIDED BY THE DISTRICT COURT, S. D. NEW YORK, MARCH 2, 1936

Feinstein claimed to have contracted trichinosis from eating pork chops bought by him from the Daniel Reeves store. In deciding the case in favor of the defendant, Daniel Reeves, Inc., the court pointed out that the cause of action was based upon a breach of an implied warranty by the defendant, Daniel Reeves, Inc., that the pork chops sold were wholesome and fit for human food. The evidence clearly shows that trichina infected pork is wholesome and fit for food when properly cooked. Pork chops are not sold to be eaten in the raw state. The warranty of wholesomeness is not that the pork is free from trichina but rather that it is fit for food when properly cooked.

Vaccarino *v.* Cozzubo

Decided by the Court of Appeals of Maryland April 8, 1943

Cozzubo's wife purchased some sausage at Vaccarino's store. Mrs. Cozzubo cooked the sausage for supper and some of it was consumed by each member of the family, all of whom became ill. Their illness was diagnosed as trichinosis. The lower courts decided in favor of Cozzubo, and Vaccarino appealed to the higher court for a review of this decision. In reversing the decision of the lower court, the higher court held that the jury should have been authorized to give a verdict for Cozzubo only in case they found that the plaintiff was infected with trichinosis by eating the sausage after it was cooked in the usual or proper manner.

Since this issue was not presented to the jury at the time of the trial, a new trial was awarded.

The following statements of the court in considering this case are quoted as being declaratory of the law of the particular jurisdiction with respect to implied warranty as it attaches in connection with a sale of pork: "While the rule of *caveat emptor* (let the buyer beware) has generally been applied to the sale of merchandise, the courts have considered the prevention of the sale of unwholesome food by retail dealers to be of such vital importance to the public health that they have recognized an exception in such cases, holding such a dealer liable on an implied warranty of wholesomeness even though he did not know it was unwholesome at the time he sold it. . . . In the case of the sale of food by a retail dealer for immediate consumption the Sales Act is declaratory of the common law holding that there is an implied warranty that the food is reasonably fit for the purpose. . . . However, no implied warranty arises either at common law or under the statute that meat generally fit to be eaten only when properly cooked is wholesome when eaten raw or cooked in an unusual or improper manner. It is a matter of common knowledge that pork is purchased to be eaten when cooked not when raw. Hence, it would be unfair to impose upon a retail meat dealer an implied warranty that his pork is fit to be eaten when raw. This is especially true in view of the fact that the danger of contracting trichinosis from eating pork can be eliminated by means of proper cooking."

Sanguedolce *v.* A. Habermann Provision Co.

Decided by the Supreme Court of Ohio, July 26, 1944

Benjamine Sanguedolce claimed that he purchased several pounds of raw pork shoulders from the defendant. He took the meat home where it was prepared for the family's Sunday dinner and was eaten the day after its purchase. Sanguedolce, along with others, ate the product and they all became violently ill. The illness was diagnosed as trichinosis and an examination of the meat showed the presence of trichina larvæ. Sanguedolce claimed that the defendant sold meat intended for human consumption that was diseased and corrupted with trichina parasites, that it was wholly unfit for human consumption, and that the meat was sold in violation of the provisions of the Ohio Pure Food Laws. The defendant claimed that Sanguedolce was guilty of contributory negligence in that he failed to properly cook the meat before eating it.

The lower courts decided in favor of the defendant and Sanguedolce appealed the decision to the Supreme Court of Ohio. Of the several sections of the Ohio statutes involved, Section 12760 is particularly in point, it reads: "Whoever sells, offers for sale, or has in possession with intent to sell diseased, corrupt, adulterated, or unwholesome provisions without making the condition thereof known to the buyer shall be fined not more than $50 or imprisoned twenty days or both."

The Supreme Court in deciding this case held that the Statute places an absolute liability on the seller of meat infected with trichina without regard to knowledge of its presence. A violation of the statute therefore, is negligence *per se*. The court goes on to say that this places a heavy burden upon the seller but he may require a warranty from the person who sells the meat to him. The seller also has a measure of protection in the obligation of the purchaser and the consumer not to eat pork in an uncooked state. One who eats pork with the knowldege or means of knowledge that it has not been properly cooked is guilty of contributory negligence precluding a recovery from the seller of such meat.

In upholding the lower court's decisions in favor of the defendant, the Supreme Court held that the trial court properly charged the jury on the subject of contributory negligence.

Kurth *v.* Krumme

Decided by the Supreme Court of Ohio July 26, 1944

Frances Kurth, as administratrix of the estate of her husband, Walter Kurth, deceased, brought suit in the Court of Common Pleas of Summit County against Karl Krumme, claiming that the death of Walter Kurth was directly due to eating a preparation called "metwurst" which was purchased from Krumme. Mrs. Kurth further claimed that the metwurst consisted in part of food that was unwholesome, diseased, corrupted, tainted or adulterated, and as such was unfit for human food.

Mrs. Kurth brought her action under the provision of the Ohio statutes relating to foods and their sale, particularly Section 12760, General Code, which provides "Whoever sells, offers for sale, or has in possession with intent to sell diseased, corrupt, adulterated, or unwholesome provisions without making the condition there of known to the buyer shall be fined not more than $50 or imprisoned twenty days or both."

The lower court granted Mrs. Kurth a verdict and judgment was entered in the sum of $3,000. The Court of Appeals upheld this decision and Krumme appealed to the Supreme Court of Ohio for a reversal.

In reviewing the case, the Supreme Court held that pork infested with *Trichinella spiralis* is diseased within the meaning of the Ohio Pure Food Laws and the violation of Section 12760 of the General Code is negligence *per se*. Upon cross-examination Krumme, an aged man of German birth, testified that metwurst is prepared by chopping fresh pork shoulders and hams into small pieces and running the resulting product through a grinder. Spices are then added and the mixture is put into a casing. The product is then smoked and it is ready for sale. He said that the meat going into the metwurst is never cooked. Krumme further testified that it was common practice for the purchaser to eat the metwurst as it comes from the butcher shop without any further preparation.

It was plain from the evidence that the defendant and his family ate the metwurst without cooking and that it was so consumed by many people.

Krumme claimed that the lower court should have found Kurth guilty of contributory negligence in not cooking the metwurst thoroughly before consuming the product, and that being the case, should have decided the action in his (Krumme's) favor.

The Supreme Court in upholding the decision of the lower court in favor of Mrs. Kurth stated that "Under all the evidence we are of the opinion that contributory negligence was a question of fact and was properly submitted to the jury. Had defendant (Walter Kurth) eaten the raw shoulder or ham of pork as it came from the slaughtered animal, a different conclusion as to contributory negligence might be required."

Chapter

6

PHYSICAL AND CHEMICAL CHARACTERISTICS OF MEAT AND THE PRINCIPAL ORGANS

THE structure and chemistry of muscle tissue, fatty tissue, and the principal organs of meat-producing animals are briefly considered in this chapter. The histology and chemistry of those tissues and organs are reviewed in a limited way.

Histology.—A knowledge of the structure of muscle tissue, fatty tissue, and such organs as the lymph glands, spleen, liver, lungs, kidneys, and mammary glands is basic in applying the principles of food hygiene to the production of meat and allied products.

Skeletal Muscles.—These are striated muscles which are under voluntary control and, for the most part, are attached to the skeleton. They also serve as voluntary sphincters and are found attached to the skin.

Fibers.—The functional unit of skeletal muscle is called a fiber. The fiber is really a large multinuclear cell. The fiber is the largest cell in the body ranging in length and thickness up to a size which is visible to the naked eye. Its greatest length is approximately 4 cm. and it ranges in thickness from 10 to 140 micra. The thickness of fibers varies somewhat in the same muscle but there is a more or less typical size for each muscle. There is some correlation between the kind of work a muscle performs and the thickness of its fibers. The fibers making up delicate muscles are much smaller than those of the bulkier muscles. As a muscle increases in size there is no increase in the number of fibers but rather in an increase in the size of its fibers.

Skeletal muscles are made up of muscle fibers held together by connective tissue and arranged parallel to each other. The fibers are combined to form primary, secondary, and tertiary bundles. The connective tissue surrounding the large bundles is called the epimysium. The connective tissue extending from the epimysium into the spaces between the bundles of muscular fibers is called perimysium. A thin, fibrous network called the endomysium continues from the perimysium to surround each muscle fiber. The type of connective tissue fibers making up the interstitial connective tissue varies according to the functional peculiarities of the particular muscle.

Completely surrounding the muscle fiber is a tough cell membrane called the sarcolemma. Inside the sarcolemma are the nuclei and the cross-striated substance composed principally of the myofibrils. There is also present the fluid sarcoplasm surrounding the myofibrils and accumulating at the poles of the nuclei. The sarcoplasm corresponds to the cytoplasm

of other cells. Stained sections of skeletal muscle are characterized by the peripherally placed nuclei and the cross-striations.

The striated muscle fiber is made up of colloid cross-striated myofibrils in a liquid sarcoplasm surrounded by a semi-permeable membrane, the sarcolemma, with numerous nuclei lying immediately under the sarcolemma.

Myofibrils.—The myofibrils give the fiber an appearance of longitudinal striation. They appear as long parallel threads which do not branch. Their thickness ranges from ultramicroscopic to as large as 1 to 2 micra.

The myofibril is composed of two main types of substances which alternate regularly along its length. These give the alternating light and dark areas which extend from one myofibril to another across the fiber giving the cross-striated appearance to the fiber.

Cross-striations.—The alternating light and dark areas or striations run the length of the fiber and are sometimes referred to as disks. The dark area is designated by the letter "Q" by some authors and "A" by others. The light area is designated by the letter "J" by those authors using the "Q" designation for the dark area and with the letter "I" by those using the "A" designation for the dark area. Through the light area runs a dark line or disk identified by the letter "Z". The amount of substance included between two "Z" lines is called a sarcomere. The sarcomere is considered to be the structural and functional unit of the skeletal muscle fiber.

There is no structural characteristic that would permit distinguishing the skeletal muscle fiber of one food-producing animal from that of another.

Cardiac Muscle.—This muscle is also cross-striated but is not under voluntary control. It consists of a network of interlacing muscle fibers which have anastomosing branches that fuse into a continuous syncytium.

Although the minute structure of the striated substance of cardiac muscle is essentially the same as that of skeletal muscle, the fibers making up these two classes of muscle tissue are quite different. The nuclei in the cardiac muscle fiber are always arranged in the interior of the fiber by contrast with the peripherally located nuclei in the skeletal muscle fiber. The myofibrils are similar to those in skeletal muscle and are composed of the same light and dark areas. The sarcoplasm is somewhat more apparent in the cardiac muscle fiber than in the skeletal muscle fiber. A very thin sheath surrounds the cardiac muscle fiber by contrast with the tough sacrolemma of skeletal muscle.

The intercalated disks in the cardiac muscle fiber also serve to distinguish it from skeletal muscle. The simplest form of this cross band runs parallel to and obliterates the "Z" line across an entire fiber. It may, however, extend across a fiber in a sort of a step formation with horizontal portions at different levels connected by slender, vertical lines. The intercalated disk is not so thick as a sarcomere ranging from 0.5 to 1 micron. The myofibrils are believed to pass uninterruptedly through these disks. Most authors do not believe that these disks are cell membranes. They appear comparatively late in the development of the cardiac muscle and their number increases with age.

Cardiac muscle has a richer blood supply than skeletal muscle.

Purkinje Muscle.—These muscle fibers make up a network under the endocardium which lines the internal surface of the heart particularly

the interventricular septum. The fibers of this muscle tissue are a lot larger than those of cardiac muscle and, like cardiac muscle, the fibers are elongated bodies with blunt ends and characterized by intercalated disks. The fibers of this Purkinje muscle also form a network of anastomosing branches. These muscle fibers are very similar in design to cardiac muscle fibers. They have centrally located nuclei and peripherally placed striated myofibrils but the proportions of the components are different than in cardiac muscle.

Smooth Muscle.—This is called non-striated, plain, or involuntary. It is not cross-striated as are the other three classes of muscle tissue and it is not under voluntary control. It is found primarily in the internal organs; it forms the contractile portions of the wall of the digestive tract from the middle of the esophagus to the internal sphincter of the anus. It also occurs in the ducts of glands connected with the intestine and in the respiratory passages from the trachea to the alveolar ducts and in the

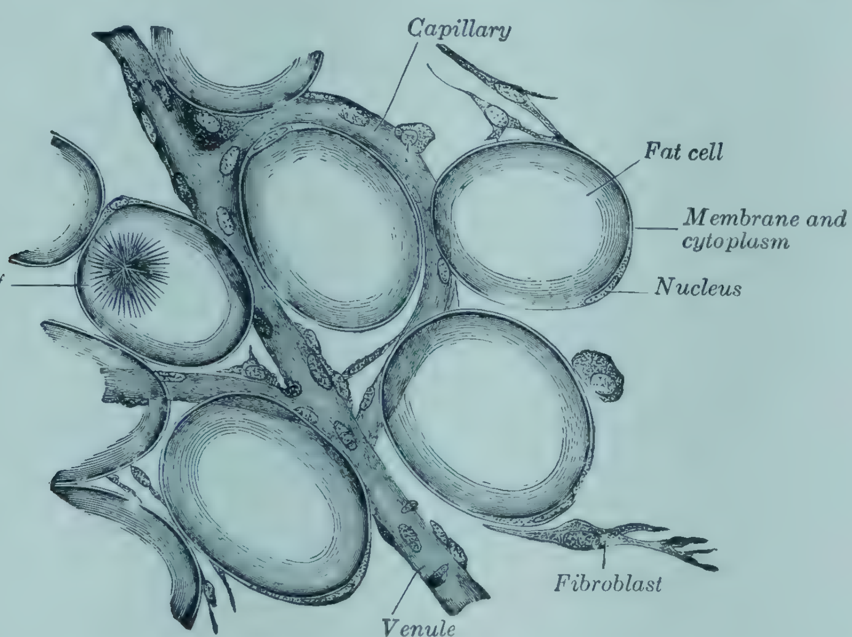


FIG. 26.—Cells for the margin of a fat lobule. (Sharpey-Schafer, Schafer's Histology, Longmans, Green & Co.)

urinary and genital ducts. Smooth muscle also makes up to a considerable extent the walls of the arteries, veins, and some of the larger lymphatics. It is scattered throughout the connective tissue of the skin and of certain sensory organs and in the capsule and trabeculæ of the spleen.

Smooth muscle is made up of long, spindle-shaped cells each with a single, centrally located nucleus. Peripherally, the cell is made up of myofibrils which upon being stained show a faintly longitudinal striation. The myofibrils do not possess the alternating light and dark areas which give the cross-striated effect to the other three classes of muscle tissue.

The smooth muscle cell does not possess a distinct membrane which corresponds with the sarcolemma of skeletal muscle. The cells are so arranged that the thick middle portion of one cell which contains the nucleus

is opposite the thin ends of several adjacent cells. Cross sections of smooth muscle show cells of varying thickness, therefore. A characteristic of smooth muscle is its intimate association with elastic connective tissue fibers. This has resulted in the description "myo-elastic" tissue by some authors.

Fatty Tissue. Fatty tissue is usually considered as being a modified type of fibrillar connective tissue differing from loose connective tissue in that the cells have taken on large quantities of fat and have lost their fiber-forming capacity. Under the microscope each cell looks like a large droplet of fat surrounded by a thin film of cytoplasm which is thickened in that portion containing the nucleus.

Fat cells are found isolated or in groups in all loose connective tissue. In those locations where they are present in large numbers and are organized in groups or lobules, each lobule is surrounded by a layer of areolar connective tissue. Each cell in the lobule is surrounded by a delicate connective tissue stroma which contains numerous capillaries. The blood supply of fat is rich and the vascular supply of each lobule is complete and independent. An artery runs to each lobule where it breaks up into a capillary network surrounding the cells. This network in turn gives rise to the intralobular veins.

Lymph Gland.—Lymph glands vary considerably in size, they are usually oval or bean-shaped with an indentation on one side where the blood vessels and efferent lymphatic vessels leave the node. The afferent lymphatic vessels pierce the capsule of the lymph gland on the convex side. This capsule is made up of connective tissue which blends with the surrounding tissue to hold the organ in place. At the indentation or hilum, there is a depression where the capsule is thickened and extends deep into the gland.

The capsule gives off trabeculæ which extend into the substance of the gland. The arrangement of the trabeculæ and the lymphoid tissue elements is different in the outer or cortical part of the gland than in the inner or medullary part.

The Cortex.—The trabeculæ extend perpendicularly from the internal surface of the capsule to form the characteristic cortical compartments. These compartments consist of lymphocytes closely packed together to form cortical nodules which connect centrally with the cords of lymphoid tissue found in the medulla. The cortical nodules are usually made up of lighter staining central areas called germinal centers where the lymphocytes are formed. The surrounding areas stain darker because of the abundant supply of lymphocytes packed together.

Immediately under the capsule and between it and the cortical nodules are lymph sinuses into which the lymph enters from the afferent lymphatic vessels. From these sinuses the lymph flows centrally passing around the nodules to enter the sinuses of the medulla.

Medulla.—The medulla differs from the cortex in cell arrangement rather than in cell components. The trabeculæ as they extend into the medulla are quite irregular and anastomose frequently. The masses of lymphocytes do not form nodules as in the cortex but appear as anastomosing cords called lymph cords. Lymph sinuses are numerous in the medulla separating the lymph cords from the trabeculæ. The efferent lymphatic vessels which leave the lymph gland at its hilum arise from the medullary sinuses.

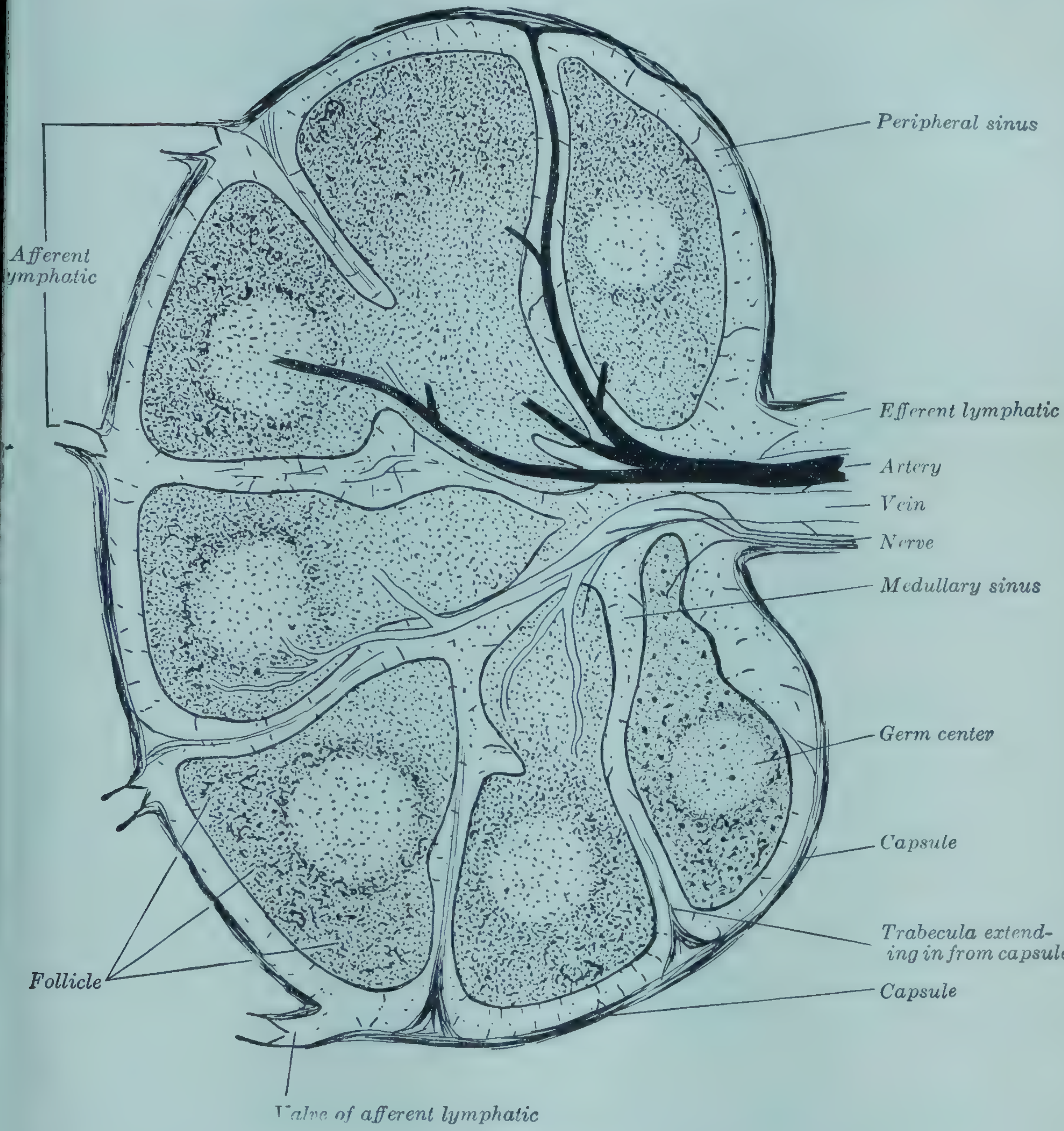


Fig. 27.—Diagram of a typical lymph gland. × about 20. (Cowdry's Textbook of Histology.)

Except for arrangement, the component parts of the lymph gland, namely, the lymphoid tissue, sinuses and trabeculæ have a similar relation throughout the gland.

The foregoing description of a lymph gland applies to the glands of all mammals but swine. The arrangement of the various tissues that make up the lymph glands of swine is virtually the reverse of that found in other mammals.

Spleen.—This organ is the largest concentration of lymphoid tissue in the body. It differs from a lymph gland, however, since it is not interposed in the flow of lymph but is inserted in the bloodstream. It has no afferent lymph vessels and no lymph sinuses as do lymph glands. Its sinuses are venous sinuses filled with blood.

The spleen is covered by a thin capsule of fibrous tissue containing numerous elastic fibers and some smooth muscle tissue. There is a thickening of the capsule at the hilum of the spleen where the blood vessels enter and leave it.

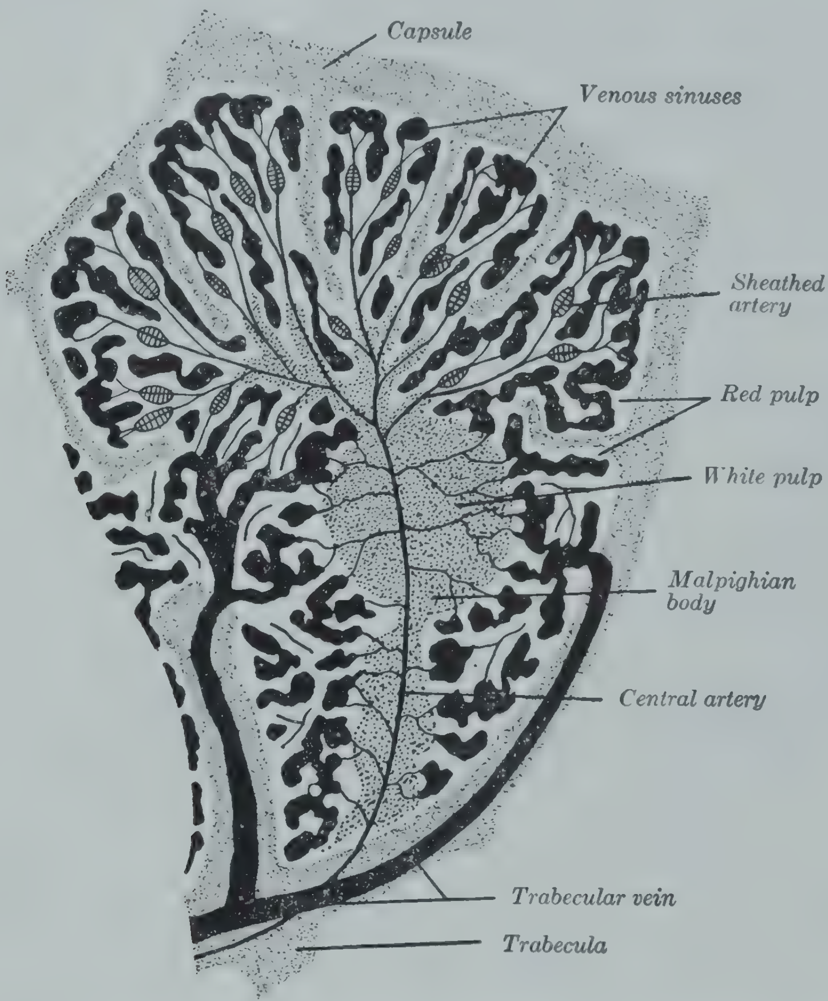


FIG. 28.—Diagram of a complete lobule of the spleen. (Redrawn and modified from Maximow-Bloom's Histology, courtesy of W. B. Saunders Company.)

Numerous trabeculæ extend from the hilum and the capsule to form the framework of the organ and divide it somewhat imperfectly into lobules. The splenic tissue which fills these lobules consists of characteristic lymphatic tissue referred to as white pulp and antypical lymphatic tissue called red pulp.

The arteries and veins follow the trabeculæ as they enter and leave the lobules.

The White Pulp.—As the branched artery leaves the trabeculæ to enter the lobule, it is surrounded by a stroma of lymphatic tissue which constitutes the white pulp.

The Red Pulp.—Between the white pulp and the venous sinuses is the red pulp which appears as a continuation from the white pulp of a modified lymphatic tissue. It is made up of a framework of reticular fibers contain-

ing in the meshes of its framework many lymphocytes, free macrophages and all the elements of the circulating blood.

Authorities disagree on the manner in which the blood passes from the artery to the venous sinuses. There are three main theories: (1) The blood corpuscles flow from the terminal capillaries into the intercellular spaces passing slowly through the red pulp and eventually entering the venous sinuses through its walls. (2) The arterial capillaries connect directly with the venous sinuses. (3) A combination of theories 1 and 2, that both types of circulation exist at the same time.

The venous sinuses which have wide, irregular lumina and whose size varies greatly are the beginning of the venous system in the spleen. They empty into veins which consist only of endothelium supported by the connective tissue of the trabeculæ. These veins follow the trabeculæ and as they proceed toward the hilum they combine to form the splenic veins.

The spleen filters the blood very much the same as the lymph nodes filter lymph.

Liver.—The liver is a compound tubular gland, the functioning units or lobules of which do not depend on a duct system but on a distribution of blood vessels that bring to it a double blood supply. The lobules are small, polygonal prisms 0.5 to 2 mm. in diameter, their height being roughly twice their diameter.

Lobule.—At the core of each lobule is a central vein which drains blood from it. The blood enters this central vein from intralobulary capillaries which are sinusoidal in form and occupy the spaces between the cords of liver cells which assume a radial position from the central vein to the periphery of the lobule. These hepatic sinusoids receive blood from the capillaries arising from the branches of the portal vein and the hepatic artery which lie in the connective tissue that separates and marks off the lobules. The blood carried from the liver by the hepatic veins originates in the central veins.

A network of bile capillaries also permeates the lobule running the length of the cords of liver cells in close proximity to them and extending between the sides of adjoining liver cells. These bile capillaries are also called bile canaliculi and they frequently anastomose with one another but are always intercellular. The flow of bile in the bile canaliculi is toward the periphery of the lobule in contrast with the flow of blood in the lobule which is towards its central vein. The bile flows into the interlobular bile duct which lies in the interlobular connective tissue. An interlobular bile duct collects the bile from several adjacent lobules.

Liver Cells.—Liver cells, also called hepatic cells occur in what are referred to as cords that extend radially from the central vein to the periphery of the lobule. These cords branch and anastomose with each other being separated laterally from each other by the hepatic sinusoids. The liver cells, which do not differ materially one from the other, perform all of the multiple and diverse functions of the liver with the exception of that performed by the Kupffer's cells.

Kupffer's Cells.—These are fixed macrophages in the lining of the hepatic sinusoids. These cells pick up foreign substances from the blood as it passes through the sinusoids and store them in their cytoplasm.

Kidney. The kidney is a compound tubular gland which serves the general function of stabilizing the composition of blood, ridding it of nitrogenous wastes and undesirable salts through a process of filtration Along with the skin and lungs it helps to maintain the constant volume of the blood by eliminating excess water which serves as the filtrate. Depending on the needs, a portion of the filtrate is reabsorbed. That which is not reabsorbed is excreted as urine.

In the side of the kidney toward the median line of the body is a large depression called the hilum which leads to a large cavity or sinus. The

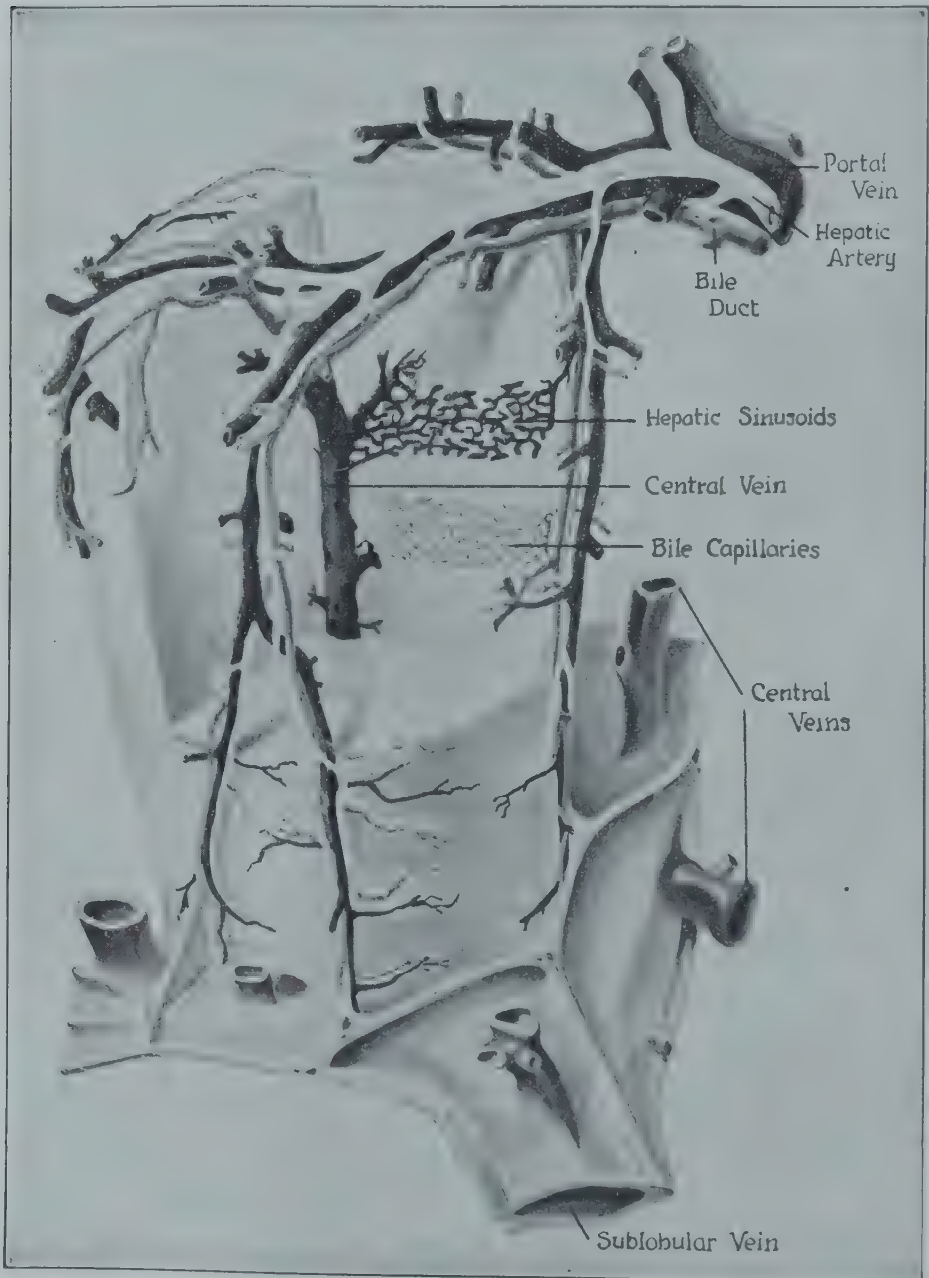


FIG. 29.—Reconstruction of a liver lobule of the pig. (From Bailey's Histology, after Braus, Anatomie des Menschen, Williams and Wilkins and Julius Springer.)

sinus is filled with loose, connective, and fatty tissue through which the vessels and nerves pass to the renal tissue. It contains the renal pelvis which is an enlargement of the excretory passages of the kidney.

The sinus is surrounded by glandular kidney tissue which is made up of cone-shaped structures called renal lobes.

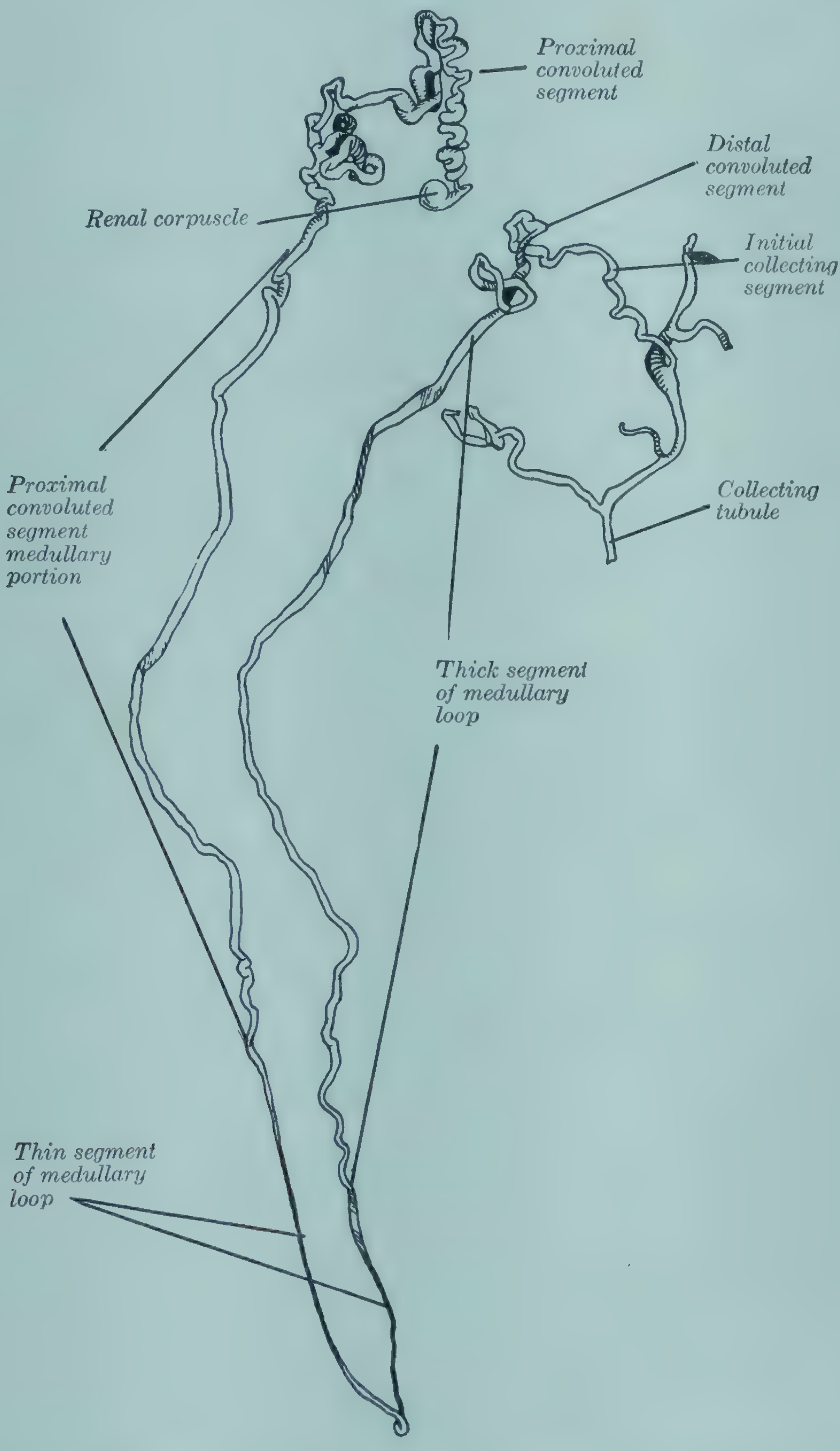


FIG. 30.—A complete renal unit (nephron) isolated by maceration from a normal kidney. × 15. (Redrawn in Cowdry from Oliver and Lund, courtesy of Arch. Path.)

Renal Lobe. The apex of the cone-shaped renal lobe fits into a minor calix of the pelvis and contains the discharge ends of the urinary collecting tubules. Each lobe consists of a medullary portion characterized by striations radiating from the apex of the cone and a cortical portion which forms the base of the cone bounded by the capsule of the kidney. The renal lobe is composed of glandular tissue and tubules that are made up of the nephrons which are the functional units of the kidney, and the urinary collecting tubules.

Nephron. This consists of a renal corpuscle with its tubule. The presence of the renal corpuscle and the convoluted tubules of the tubular portion of the nephron in the cortical portion of the lobe gives it its characteristic appearance. The medullary portion of the lobe gets its radiating striated appearance from the fairly straight ascending and descending portions of the tubules of the nephron and from the urinary collecting tubules.

In the renal corpuscle is a mass of arterial capillaries called the glomerulus. This tuft-like capillary network lies in the invaginated expanded end of the tubule. This forms a two-layered capsule making up the renal corpuscle. Both the afferent and efferent vessels of the capillary network are arterioles. Each tubular secretory portion begins with the renal corpuscle and ends at its junction with the excretory ducts. As the tubule leaves the renal corpuscle, it forms the proximal convoluted segment which follows a very tortuous course. From here the tubule descends as a comparatively straight medullary portion forming a loop at its farthest end in the medulla, continuing to ascend as another comparatively straight portion through the medulla to the cortex where it forms the distal convoluted segment from which it proceeds to the urinary collecting tubule. This tubule then descends through the medulla, picking up other tubules on the way to discharge at the apex of the lobe into the urinary pelvis.

Lung.—The trachea as it enters the thoracic cavity divides into bronchi which enter the lungs at each hilum. As these bronchi enter the lungs they possess the same general structure as the trachea, but soon after they enter the lungs the cartilage rings are replaced by irregularly shaped plates of cartilage which completely surround the bronchus. The bronchus is also completely surrounded by a muscular layer. These bronchi divide into smaller bronchi and these in turn divide into bronchioles.

Bronchioles.—As the diameter of the bronchioles reaches approximately 1 mm. the cartilage disappears entirely and they are surrounded by an interlacing mesh of smooth muscle intimately associated with elastic fibers. Most authors divide the bronchioles into two classes: (1) Those forming the terminal part of the air-conducting system of tubules, and (2) the respiratory bronchioles formed by branching of the terminal conducting bronchioles. The first class is, as the name implies, entirely air-conducting tubules, while the respiratory bronchioles are characterized by the budding of a few alveoli from their sides.

The successive divisions of the bronchial tree are: primary bronchi, secondary bronchi, bronchioles, terminal bronchioles, respiratory bronchioles, alveolar ducts, alveolar sacs, and alveoli.

Alveolar Sacs and Alveoli. The respiratory bronchioles branch and

these branches radiate cone-like into several alveolar ducts. Each duct extends for some distance as thin-walled tubes following a tortuous course with some branching. Along these ducts occur the closely set out pouchings which constitute the alveolar sacs. These sacs are blind, thin-walled, and polyhedral, closely packed one against the other. The openings into the sacs form the greatest part of the wall of the alveolar duct. In addition to alveolar sacs, single alveoli also occur as out pouchings from the alveolar ducts. The wall of the alveolar sacs consists of several out pouchings forming the alveoli.

The capillaries in the alveolar walls are numerous and anastomose freely filling up entirely the space between adjoining alveoli. Occurring along with the branching capillaries is a closely meshed network of branching reticular fibers which support the thin-walled alveoli and their numerous capillaries. A number of elastic fibers are also present in this network. There have been demonstrated openings or pores through the walls separating the alveoli which permit them to communicate with one another. There is some controversy concerning the nature of the cell structure lining the alveoli. Whatever its structure there is little tissue between the capillaries and the alveolar gases.

Mammary Glands.—These are large cutaneous glands each consisting of a number of compound alveolar glands. Each mammary gland is covered by a layer of connective tissue from which septa extend into the body of the gland separating it into lobes. Fine connective tissue bands pass from the septa into the lobes dividing it into lobules forming the supporting structure of the glandular tissue.

The Inactive Gland.—Prior to the first pregnancy and between periods of lactation, the mammary gland consists principally of connective tissue and collapsed branching groups of excretory ducts and groups of alveoli. The outside layer of connective tissue often contains considerable fat. The interlobular connective tissue of the inactive gland consists of rather densely arranged collagenous fibers with fat sometimes being present in considerable amounts. An entirely different structure makes up the intralobular connective tissue. This tissue furnishes a nutritive and expanding medium for the growth and development of the alveoli preparatory to the active stage of the gland. This intralobular tissue is rich in cells and blood vessels, with no fat cells, and has a delicate distribution of collagenous fibers.

The Active Gland.—As the gland develops during pregnancy for its lactation function, its microscopic appearance changes greatly from that of the inactive gland. The intralobular connective tissue becomes thin septa which enclose large lobules consisting of densely packed ducts and alveoli. These alveoli in the process of secretion are irregular in shape and vary considerably in size. The appearance of ducts and alveoli is not uniform throughout the gland, varying considerably in different stages of functional activity. The secretory lining of the alveolar ducts and the alveoli consists of basement membrane, a layer of myo-epithelial cells with a row of low columnar glandular cells lining the internal surface.

During secretory activity, the low columnar glandular cells become elongated and swollen and minute droplets of fat appear in their protoplasm.

These unite to form several large droplets toward the free end of the cell from which they are discharged into the lumen of the duct or alveoli. The free end of the cell itself also becomes detached into the lumen from the basal nuclear position. The remaining glandular cell is low cuboidal in shape and soon regenerates its lost protoplasm to repeat the secretory process.

Chemistry.—The chemical composition of animal tissues has been examined both with respect to their physiological functioning and their nutritive and commercial value. Chemical analyses and determinations made in this connection furnish information which is useful in gaining an understanding of the composition and reaction of animal products as they are handled and prepared as articles of human food.

Muscle Tissue.—More work has been performed on the chemistry of striated muscle than on smooth muscle. For the purposes of meat hygiene the composition of striated muscle tissue has considerably more significance since meat consists of this class of muscle tissue. Approximately 75 per cent of water and 25 per cent of solids make up striated muscle. Approximately $\frac{4}{5}$ of the solids consists of protein with the remainder being made up of "extractives" and inorganic solids. According to Mitchell, the protein content tends to be higher in smooth muscle than in striated muscle.

Muscle Proteins.—Myosin 67 to 68 per cent, globulin X 21 per cent, myogen 10 per cent, myoalbumin 1 per cent, muscle hemoglobin (in red muscle) less than 1 per cent. Myosin is the most thoroughly studied of all the muscle proteins. It is the major, if not the only protein of the myofibril and is, therefore, considered to play a major role in muscle contraction. It has been found to possess enzymatic properties which enter into the metabolism of muscle tissue that supplies an important part of the energy of contraction. There appears to be some uncertainty, however, as to whether the myosin molecule actually possesses enzymatic properties itself or whether such properties are adsorbed on the molecule.

Myosin undergoes a type of denaturing during rigor mortis when it coagulates and becomes insoluble; this causes the characteristic stiffness of rigor mortis. Mirshky and Anson have shown that there is a change in the sulfhydryl and disulphid groups when proteins are coagulated by denaturing agents, such as heat and acid. Myosin coagulation in rigor mortis is not accompanied with any change in its sulfhydryl and disulphid groups. The coagulation of myosin in rigor mortis appears to resemble its process of coagulation as demonstrated by Mirshky when caused by dehydration. During this process it loses solubility without any change of its sulfhydryl and disulphid groups.

Globulin X, myogen, and myoalbumin appear to be proteins of the sarcoplasm.

Muscle Hemoglobin.—This is an iron-porphyrin protein and is similar to the hemoglobin of blood. Muscle hemoglobin is one of the hemo proteins which also include blood hemoglobin, the cytochromes, peroxidases, and catalases. Muscle hemoblogin, like blood hemoglobin, is a combination of globin with reduced heme, the iron in the muscle hemoglobin molecule being in the ferrous state. The term "heme" is used as the equivalent of ferriprotoporphyrin.

Muscle hemoglobin contains only one heme group per molecule and has an estimated molecular weight of 17,200 by contrast with blood hemoglobin which has four iron atoms in its molecule with a molecular weight of 66,800 according to Svedberg.

Muscle hemoglobin, like blood hemoglobin, takes on oxygen in two distinctly different ways. One a loose linkage called oxygenation, the other a true oxidation.

In its physiological role of storing and transporting oxygen, as it contributes to muscle metabolism, myohemoglobin takes on oxygen reversibly without changing its iron atom from the ferrous to the ferric form. This combining of muscle hemoglobin and oxygen has been called oxygenation and forms muscle oxyhemoglobin. The muscle oxyhemoglobin readily gives up its oxygen when the oxygen pressure is lowered within the cell. Millikan describes this by saying that the activity of muscle hemoglobin for oxygen to form muscle oxyhemoglobin lies between that of blood hemoglobin and the oxidases so that it is well adapted to take up oxygen from one and give it to the other.

Muscle hemoglobin may be actually oxidized to form a brown colored product called muscle methemoglobin which has its iron in the ferric condition. Muscle oxyhemoglobin and muscle methemoglobin contain the same amount of oxygen but the latter does not lose its oxygen when the pressure is reduced.

According to Millikan, muscle hemoglobin is much more easily oxidized to the met form than blood hemoglobin. Hemin catalysts probably owe their activity to their easy alteration between the bivalent and trivalent states. Muscle hemoglobin in this property is more like an enzyme than is blood hemoglobin. He finds that it appears to be at a sort of half-way station or connective link between oxygen carriers and oxygen catalysts.

Muscle hemoglobin also reacts with many other compounds such as carbon monoxide, nitric oxide, hydrogen sulphide, and ferricyanide.

Cytochromes.—These are mentioned because they are also iron-porphyrin proteins consisting of a combination of globin and reduced heme. Three cytochromes, a, b, and c, have been identified by their distinct absorption bands. Cytochrome c is the only one that has received satisfactory chemical investigation. Mitchell states that it is now believed that one or more of the cytochromes can be found in every cell which respires aerobically and that nearly all the respiratory activity of such a cell depends on them. According to Millikan, all active muscle tissue contains considerable amounts of cytochrome whether it contains the muscle hemoglobin or not, however, in red muscle, muscle hemoglobin may have a concentration 50 times that of cytochromes. Theorell describes cytochromes as exercising their effect through the oscillation of the valency of the iron from ferrous to ferric. Since electrons are received from one quarter and given off to another, cytochromes transport a stream of electrons leading from hydrogen-transferring enzymes toward molecular oxygen.

Extractives—Nitrogenous.—The extractives in this class are believed to give meat its flavor. They include creatine, phosphocreatine, purine bases, adenylic acid, carnosine, anserine, inosinic acid, uric acid, and carnitine. In addition to these, others have been described and still others

are probably present but so far have not been detected. Many are produced largely by post-mortem reaction and are not present as such in significant amounts in living tissue.

Non-nitrogenous.—Glycogen is the principal carbohydrate of muscle tissue and according to Mitchell constitutes up to 1.5 per cent in mammalian striated muscle. Glycogen content may be very nearly exhausted by intense muscular activity. The amount of glycogen in the muscle tissue is not significantly reduced by carbohydrate demands elsewhere in the body. Muscle tissue does not serve as a storage place for glycogen.

Hexosephosphate, lactic acid, inositol and fat make up the other principal non-nitrogenous extractives.

A large number of enzymes are present in muscle tissue. Some have received a considerable amount of attention in connection with the study of the phenomena of muscular contraction. Some have been identified with post-mortem changes. Others have not been well characterized.

Meat is a good source of some but only a fair source of others of the B group of vitamins. Meat is a fair source of ascorbic acid but does not contain significant amounts of fat soluble vitamins.

Inorganic Salts.—Potassium is the predominant cation in muscle tissue. Other cations are sodium, magnesium and calcium. Phosphate is the principal anion and is probably, for the most part, tied up in adenosinediphosphate (ADP) adenosinetriphosphate (ATP) and phosphocreatine. The free inorganic phosphate found on analysis according to Hawk, Oser, and Summerson may have been produced by the decomposition of ATP and phospocreatine. Other anions are chloride and traces of sulfate.

pH of Muscle Tissue.—The resting muscle is neutral but becomes acid after death due to the production of lactic acid. The lactic acid is produced at the cost of the glycogen content of the muscle at the time of death. Accordingly, the degree of acidity depends on the amount of glycogen and it is also self-limiting since the enzymatic action becomes retarded at or a little below pH 5.4. As a practical matter, it is unusual for muscle to contain sufficient glycogen to produce a pH as low as 5.4.

Actually, it is difficult to evaluate the exact pH of muscle at the time the animal is slaughtered and immediately prior to cessation of circulation. It depends on the history of muscular activity. The lactic acid content of muscle functioning aerobically will be very low. It is probable that the pH of a muscle at the time of slaughter is in the neighborhood of 7.4.

While the degree of change in pH of muscle tissue after death has a profound effect on the physical properties of the proteins making up the fibrils, it is not considered to be the principal factor in the development of rigor. Rigor has been demonstrated to set in without any change in pH whatever and appears to be associated with the disappearance of ATP (adenosinetriphosphate) in the muscle tissue. The difference in physical characteristics possessed by meat of high pH and meat of low pH is related to the condition of the substance of the fibrils making up the muscle tissue. Associated with high pH is a closeness of structure with the fibrils lying closely packed along the grain of the meat. There is an openness of structure associated with a low pH brought about by a shrinking of the substance making up the fibrils.

This closeness of structure of the muscle tissue in meat of a high pH

produces the so-called dark cutting of beef. This deep, dark red color is explained as resulting from the light being reflected through a deep layer of pigment. The actual amount of pigment present in the meat does not vary with the pH. The paler red color of light cutting beef is considered to be due to the scattering of the light by the more open structure of the superficial layers in meat having a low pH.

The other characteristics associated with differences in pH and related to the structure of the fibrils have to do with salt penetration, and the effect of heating on the moisture content of the meat. Meat of high pH because of the closeness of the structure does not take on salt in the curing process as readily as meat of low pH. Meat of high pH does not yield its juices on cooking as readily as meat of low pH.

Bacterial growth has been found to be more vigorous on meat of high pH than on meat of low pH. The growth of bacteria on meat of high pH is more abundant because of the lack of acidity rather than the closeness of structure of the muscle tissue.

Connective Tissue.—*White fibrous.*—According to Gies and his associates there is 62.9 per cent water in white fibrous connective tissue and 37.1 per cent solids. The albuminoid collagen makes up 86 per cent of the solid constituent, elastin 4.5 per cent (also an albuminoid), and the glycoprotein tendomucoid 3.5 per cent. The remaining solids are described as ether-soluble material, "extractives". and inorganic matter.

Collagen is insoluble in all reagents which do not change it. It is not soluble in the usual protein solvents. Collagen has the property of being converted to gelatin by boiling water. This appears to be largely a physical alteration. Gelatin differs from collagen in being easily soluble and digestible. Collagen is digested by pepsin-hydrochloric acid and also by trypsin at temperatures above 40° C. but best by successive action of both enzymes.

Yellow elastic.—This class of connective tissue is made up of 57.6 per cent water and 42.4 per cent solids. By contrast with white fibrous connective tissue, elastin makes up 75 per cent of the solid constituent of yellow elastic connective tissue with collagen 17.1 per cent, and tendomucoid 1 per cent. The composition of the remaining solids is similar to white fibrous connective tissue.

Elastin resembles collagen in that it is insoluble in protein solvents, however, it is not changed to gelatin by boiling water. Elastin is digested slowly by pepsin and trypsin but differs from collagen in amino acid composition.

Fatty Tissue.—According to Winton, the walls of fat cells consist of elastin or a similar substance. The connective tissue stroma supporting the fat cells consists of a mingling of collagenous fibers with elastic fibers varying in their relative amounts according to their location in the body.

Animal fats from various sources differ considerably in their fatty acid content. Animal fats as they occur naturally are mixtures of individual fats and consist for the most part of mixed glycerides of oleic, palmitic, stearic, linoleic, and myristic acid. Lard also contains small amounts of highly unsaturated C_{20} and C_{22} acids, traces of which are also reported as occurring in beef and mutton fats. Animal fats derived from internal tissues, such as kidney and abdominal fats, are harder and less unsaturated than those from tissues near the skin.

Chapter

7

FACILITIES RELATING TO SANITATION IN PLANT OPERATION

THIS chapter deals with the physical aspects of the meat packing plant and its premises, the plant equipment, and facilities generally as they have a bearing on environmental sanitation. The cleanliness and wholesomeness of meat bear a direct relation to the kind of facilities which make up its environment.

Water Supply.—The characteristics of good quality in drinking water are epitomized in the 1941 Manual of the American Water Works Association as "A water supply should be clear, of neutral taste, of reasonable temperature, neither corrosive nor scale-forming, not so mineralized as to produce unfavorable physiological effects, and containing no organisms capable of producing intestinal infections."

A meat packing plant requires an abundant water supply. Since such uses as are connected with cooling compressed ammonia in the refrigeration system, washing hashed inedible offal preparatory to inedible rendering, and condensing vapors discharged from inedible rendering tanks might be accomplished with non-potable water, meat packing plants frequently have a non-potable water system as well as a potable one. The potable water system meets the standard of quality for drinking water. The distribution of the non-potable supply is such as to preclude its contaminating the potable supply or edible products.

Standard of Quality.—Four considerations enter into determination as to whether a water supply is acceptable as potable for use in the edible products departments of meat packing plants. They are the source of the supply, the water's physical characteristics, its bacteriological pollution, and its chemical pollution. A potable water supply is evaluated in terms of limits of permissible impurity.

Source.—When the potable water supply of the meat packing plant is obtained from a municipality it is generally a safe supply and the principal concern is to maintain its safety during its distribution and use in the plant.

The source of a private supply is examined and evaluated to exclude the probable sources of pollution.

Deep-seated or artesian waters, except those from fissured rocks usually contain few bacteria. Waters in limestone and fissured rocks often carry pollution for many miles. Dug wells, or shallow wells in surface deposits, even though in fine-grained material, may be polluted by surface waters through rifts, crawfish holes, or other direct channels. Accordingly, areas

around such wells require protection for considerable distances. The tributary area around such a well is widened by increased draft.

Ground waters as a class have great solvent power and are therefore usually hard and highly mineralized. The most common dissolved minerals are salts or calcium, magnesium, sodium, iron, and silica. The most common dissolved gases are carbon dioxide and sulphureted hydrogen.

On page 330 of the Appendix is reproduced the form used by the Federal Meat Inspection Service in obtaining information concerning private wells. The depth of the well, whether it is drilled or dug and the size of the well bore is considered in relation to the nature of the soil strata, and the location of the well with respect to buildings, livestock pens, sewers, and the like. The proximity of the well to such surface water as streams, rivers, ponds, and swamps is significant. The location of the well as to whether it is on low or high ground and whether the slope of the ground is toward it or away from it are of importance as they concern the probability of pollution by surface waters. The height of the top of the casing with respect to the ground level also has significance with respect to possible surface water contamination. The effects of rains and seasonal changes on the well water are indicative of the character of the tributary area.

Physical Characteristics.—Turbidity does not exceed 10 (silica scale). Turbidity of water results from finely divided suspended material. Measurement of turbidity is based on the optical obstruction of light rays passed through a sample when compared, under the same conditions, with an arbitrary standard turbidity scale. The standard unit of turbidity is that produced by one part per million of silica in distilled water.

Color does not exceed 20 (platinum-cobalt scale). Similar to the measurement of turbidity, an arbitrary standard scale is used as a means for comparison of color intensity with the water sample. The fact that a water possesses a color of 20 units means that the intensity of the color of the sample is equal to the intensity of the color of distilled water containing 20 milligrams of platinum (as potassium chlorplatinate) per liter. Waters usually vary from colorless to deep brown. Color in natural water is found generally to be due to the presence of tannin in solution (from decayed vegetation) or from various industrial wastes.

The water is free from odor of such substances as hydrogen sulfide or chlorine. Also, the water contains no odor caused by the presence of microorganisms. Odors traceable to the presence of microorganisms usually fall within three groups: Aromatic, caused by diatomaceæ and a few protozoa; grassy, caused by cyanophyceæ and chlorophyceæ; and fishy, caused by chlorophyceæ, diatomaceæ, and protozoa.

Bacterial.—The vast majority of bacteria found in drinking water supplies are entirely harmless and regulations designed to insure freedom from disease-producing bacteria are, accordingly, concerned more with the character than the numbers of bacteria present.

Since practically all of the diseases known to be commonly transmitted through water are due to organisms which are discharged from the intestines of infected persons, pollution with intestinal discharges is not only the most offensive but by far the most dangerous to which water supplies are exposed. Typhoid fever organisms, so far as known, develop only

in the bodies of infected persons and are discharged in the feces and urine. Tests for bacteria of the B. coli group afford a direct measure of the numbers of intestinal bacteria present. Since typhoid bacilli are found only in association with intestinal discharges, these tests have the most sanitary significance of any that can be made in a laboratory.

All water, whether taken from surface or underground sources, has at some time since its precipitation been in contact with the surface of the earth and has consequently been more or less exposed to pollution with intestinal discharges of persons and lower animals upon its catchment area. Between the sources of pollution and the ultimate destination of the water are numerous agencies operating to reduce the number of typhoid bacilli and other intestinal bacteria which may reach the consumer. It is obviously desirable that drinking water be at all times entirely free from such offensive and dangerous pollution, but it would be both impracticable and unnecessary to enforce a requirement that water be entirely free from bacteria of the B. coli group. The limit of permissible pollution contemplated in the following standard of bacteriological quality is as rigid as it can be made without requiring absolute freedom from such bacteria. Starting with Item 4 "Samples" on page 190 through Item 9 on page 199 of the 9th Edition published in 1946 of the "Standard Methods for Examination of Water and Sewage" which is prepared, approved, and published jointly by the American Public Health Association and the American Waterworks Association, is the accepted method for water examination for bacteriological contamination. A reprint appears on page 323 of the Appendix. Beginning on page 329 of the Appendix is an excerpt from Reprint No. 2679 from the Public Health Report of March 15, 1946 which relates the findings obtained from applying the standard method for water examination to the 1946 Public Health Service Drinking Water Standard.

Disinfection Methods.—Every effort is made to obtain a potable water supply without using a disinfection method when a private supply is used. The source of the private water supply is examined carefully to detect any probable contamination from surface waters. Also, the storage and distribution systems in the meat packing plant are gone over thoroughly to make sure that there is no point where the water is being contaminated. When all probable sources of contamination have been eliminated and the water supply does not meet the bacteriological test, then a disinfection method, usually chlorination is used.

Chlorination.—Although chlorination is used to obtain reduction in the bacteria content of water, it also has the side effect of oxidizing organic matter and certain minerals. It may even correct certain odor defects in a water supply. In recent years, ammonia gas has been used in combination with chlorine. The two used in combination give better results than chlorine alone.

The quantity of chlorine required for effective bacteria reduction is determined solely by the "chlorine demand" of the water. Sufficient chlorine must be added to satisfy the demands of the readily oxidizable components in solution and other materials which possess capacity for absorbing chlorine in one way or another. There must be sufficient addi-

tional chlorine added to provide some residual chlorine over and above this chlorine demand so that it may act as a germicidal agent.

Once the minimum residual chlorine required for the destruction of bacteria has been determined by bacteriological check, and that amount above which chlorine taste appears has also been determined, control of the amount of chlorine added to the water may be arranged so as to keep safely within these limits.

There is evidence to show that chlorination causes bacteria to completely disappear by the process of lysis. In pasteurization, for example, the dead bacteria may be found after the process, whereas, after chlorination none are revealed on microscopic examination.

Ultra-Violet Ray.—This process consists in the direct application of ultra-violet rays to water as it flows through a transparent pipe containing a succession of restricted orifices wherein the depth of penetration of the rays can be governed. The effective penetration in a clear and relatively colorless water may be as much as twelve inches. Ordinarily the lamps use a direct current of 220 V and 3.5 amperes. They are arranged in tandem on the principle that successive treatment of the water by the rays gives assurance of better results.

The effect of the ultra-violet ray treatment is restricted to disinfection. The process is attractive because nothing is added to the water that may impart offensive tastes and odors. The disadvantage of this method of disinfection, however, is that the lamps require rather constant attention and the safety of the system depends on the flow of water stopping automatically when a lamp gets out of order.

Chemical Test.—Chemical analysis of water in recent years has been concerned almost entirely with enforcing tolerance limitations set for the following elements. Acceptable water supplies contain not more than 0.1 p.p.m. of lead, 3.0 p.p.m. of copper, 15 p.p.m. of zinc, 250 p.p.m. of sulfate, 125 p.p.m. of magnesium, 250 p.p.m. of chloride, 0.3 p.p.m. of iron and manganese together, and 0.05 p.p.m. of arsenic, 0.05 p.p.m. of selenium, 0.05 p.p.m. of hexavalent chromium, 0.001 p.p.m. of phenolic compounds in terms of phenol, and 1,000 p.p.m. of total solids. Treated waters are required to contain no caustic alkalinity, no odor or taste of free chlorine, and not more than 50 p.p.m. of alkali carbonates.

Prior to about 1890 attempts were made to judge the sanitary quality of water chiefly on its chemical analysis with more or less consideration given to conditions at the source. The chemical composition of water is, however, subject to the effects of many varying factors. With the development of bacteriological methods chemical analyses have received less and less attention except for comparative purposes and the purposes referred to in the preceding paragraph.

Distribution.—Whether the potable water supply is obtained from a municipality or from a private supply, its distribution in the plant must be such as to assure that it retains its quality until it is used. Storage tanks are so constructed and maintained that they can be kept clean. It is generally considered to be necessary to cover tanks to protect the water from contamination by particles from the air and bird droppings. The

covers of tanks are so constructed as to permit ready access for inspection and cleaning whenever necessary.

Sometimes potable water is stored in a tank and held for the emergency of fire. The water in such tanks is changed periodically so that its potable quality may be maintained and not be a source of contamination of edible product should a fire occur in the plant. The pipelines used for distributing potable water throughout the plant are free from dead ends in which water might stagnate and become a source of pollution. Similarly, the water in sprinkler systems is changed from time to time so that should a fire occur, the water from such a system will not unduly contaminate edible products throughout the plant.

Potable water is frequently the only water available for use in cooling the compressed ammonia in refrigeration systems and where such water is purchased from municipalities it might involve an item of considerable expense. . In such cases, so-called closed systems are used in which the water passes through the ammonia coils in closed pipes. Then there is no pollution of the water since it is not exposed to the air and the tempered water as it leaves the ammonia coils enter the plant's hot water system available for potable uses.

Water is commonly permitted to run over ammonia coils arranged in batteries located in towers on the roofs of meat packing plants. The water in such towers is exposed to the elements and experience has shown that pollution of the water is difficult to avoid. Such water, therefore, is not returned to the potable water system of the plant but is conveyed to a cooling tower in which the heat is removed from the water by spraying it in a circulation of air. After cooling, the water is again used over the ammonia coils.

The distribution of non-potable water in a plant is surrounded with such safeguards as are necessary to avoid its contaminating the potable water or edible product. This is done whether the non-potable water as such is brought into the plant, or as is the case with water used over ammonia coils, it becomes non-potable through its use in the plant. Large volumes are used for purely technical purposes outside of edible products departments. In addition to its use in cooling compressed ammonia it has a considerable use in the inedible products rendering department. A major part of the inedible materials which comes to the inedible rendering department consists of portions of the alimentary tract and its contents. Before this material is placed in the rendering tank its contents must be removed and the degree of effective removal has a direct bearing on the quality of the resulting tankage and inedible fats. Preparatory to rendering, this viscera is passed through large hashers and effectively shredded. This shredded mass is discharged immediately into equipment in which it is washed thoroughly of the ingested materials. A large amount of water is necessary for this washing and for this purpose non-potable water is suitable.

During the rendering of inedible materials the vapors that are exhausted from the inedible rendering tanks are condensed by subjecting them to a shower of cold water. Here again, a large amount of water is used and it may be non-potable.

These uses of non-potable water are such as to permit it being excluded entirely from edible products departments. Furthermore, the equipment in which it is used permits the effluent being confined and directed immediately to the sewer. Pipelines of non-potable water in a food processing plant, however, are potentially dangerous in that cross-connections between such lines and lines containing potable water may be made even though accidentally. Accordingly, lines containing non-potable water are painted a distinctive color and where a cross-connection between the potable and non-potable lines is made, its purpose is justified and it is of a type which will not permit contamination of the potable supply. An example of the necessity for a cross-connection would be the need for using potable water over the ammonia coils should there be a failure of the non-potable supply. A usual justification for a cross-connection is connected with fire control.

An acceptable cross-connection accomplishes a complete break between the two lines when not in use and a bleeder to eliminate any leakage from the non-potable side. An official seal is placed on the valve on each side so that any tampering with either valve can be immediately detected.

Measures are taken to avoid contamination of the potable water supply by back-siphonage into it of water from equipment to which the potable water system is connected or which it supplies. This refers to the water in water vats of all descriptions used in the processing departments throughout the plant and what is more repulsive, the water in toilet bowls. If for some reason a negative pressure develops in a water line, back siphonage occurs if the end of the water line is submerged in the water in the tank or bowl with the result that their contents will be sucked back into the water system. Devices called vacuum breakers are available for inserting in water lines whose ends are submerged in a tank or bowl of water. These devices work on the theory that should a negative pressure develop in the line, air will enter the line through the so-called vacuum breaker. The safest measure is to not have any submerged water lines. It is better that the discharge end of all water lines be some distance above the level of the water in the tank or bowl.

The responsibility of the inspection is a continuing one with reference to water supplies. The quality of the water is checked periodically to assure its safety, and its distribution in a plant is under constant surveillance to maintain it in a safe condition until use.

Chemical Conditioning.—Chemical conditioning of water supplies has a three-fold purpose (1) water softening, (2) avoidance of precipitation of salts to form scale in boilers and hot water systems, and (3) control corrosion in the distribution system in the plant. Hardness in water is usually referred to as carbonate (temporary) and sulphate (permanent). It is caused by calcium carbonate and magnesium carbonate held in solution by dissolved carbon dioxide and calcium sulphate and magnesium sulphate in solution. The calcium carbonate and magnesium carbonate are thrown out of solution by anything which will eliminate the dissolved carbon dioxide. The heating of water drives off the carbon dioxide and results in the precipitation of these carbonates in the boiler and hot water system.

Soft water is important as a convenience and economy since soap has very little cleansing action until it lathers and it will not lather until the

hardness salts in the water have been neutralized. The most expensive method of softening water is by the use of soap

Lime-Soda Softening.—Calcium and magnesium bicarbonate are soluble in water because they are held in solution by carbonic acid and therefore in order to remove them from the water it is necessary to convert them into insoluble normal carbonates by driving out or absorbing the carbonic acid. Carbonic acid may be driven out of the water by boiling or it may be absorbed by lime. When lime is added to hard water containing calcium and magnesium salts its action is two-fold. It neutralizes or absorbs the free and half-bound carbonic acid, thus leaving the insoluble normal carbonates to settle out and precipitates the magnesium sulfate in the insoluble hydrate form. The soda ash is necessary to act upon the sulphate hardness by effecting an exchange of sodium for calcium in combination with the sulphate radical precipitating out the calcium as calcium carbonate. The soluble magnesium sulphate is acted on by both the lime and the caustic soda precipitating out the magnesium as the insoluble magnesium hydroxide.

This process accomplishes both softness in the water and the removal of salts which otherwise become deposited in the boiler and hot water system. The sludge consisting of calcium carbonate, magnesium carbonate, and magnesium hydroxide is eliminated as part of the process of treatment.

Sodium Zeolite Softening.—This method of softening is sometimes referred to as the base-exchange process and depends on the ability of certain insoluble substances—chiefly silicates— to exchange bases with those in the water with which they are brought in contact. When hard water is passed through a bed of sodium zeolite the calcium and magnesium in the hard water are replaced by sodium from the zeolite. This treatment can be taken to a degree of thoroughness which practically eliminates the calcium and magnesium ions. The sodium salts which remain soluble in the water have no hardening effect on the water, neither do they precipitate out in the boilers or hot water systems.

After the readily replaceable sodium in the zeolite bed has been exchanged for calcium and magnesium from the hard water, the "exhausted" zeolite is regenerated with a solution of sodium chloride by which process the calcium and magnesium of the exhausted zeolite are replaced with a fresh supply of sodium from the regenerating brine solution. The zeolite after being washed with water to free it from brine is ready to soften a fresh supply of hard water.

Hexametaphosphate Treatment.—This is not a water softener. Sodium hexametaphosphate is an inorganic chemical which, when added to the water, will prevent the formation of carbonate scale in the distribution system including the boilers and hot water system and at the same time it retards corrosion.

It has been found that sodium hexametaphosphate is very strongly adsorbed on the surface of many metals, metal oxides, and salts. It is probable that an adsorbed film of this chemical prevents the crystal growth as the calcium and carbonate ions begin to build up in the solution. One part per million of sodium hexametaphosphate when added to water

before chlorination or before the water has had an opportunity to absorb oxygen, for each part per million of iron in the water has been found to prevent the precipitation of dissolved iron. This prevents the development in the water of the condition known as "red water." Similarly, the chemical acts to retard corrosion in the water distribution system.

Sodium hexametaphosphate does not remove the salts which cause hardness in water, it merely acts on them in such a way as to prevent their forming a scale in the water distribution system. It is used in combination with either the lime-soda or the zeolite treatment for its action on any of the residual carbonates and for its anti-corrosion effect.

Liquid Waste Disposal.—Since large quantities of water are used in connection with many operations involving both edible products and inedible products in a meat packing plant, adequate liquid waste disposal facilities are imperative. There are two systems of disposal in the plant entirely independent of each other; the sanitary lines which carry the wastes from toilet rooms and dressing rooms do not connect within the plant in any way with the lines which pick up and remove other liquid wastes throughout the plant. This complete separation is necessary to avoid the kind of contamination that would result from wastes from the sanitary system backing up into edible products departments should a stoppage in the lines occur.

The lines of both systems consist of cast iron or wrought iron pipes with tight leaded or threaded joints. The size of the pipe lines is adequate to carry the peak load. Clean-out fixtures are so located throughout each system that, should a stoppage occur, it can be promptly corrected. These clean-out fixtures are so placed that they can be used without constituting a threat of contamination to edible product and the openings used for clean-out purposes are so constructed and maintained as to be absolutely leakproof when not in use.

Deep seal flowing traps are installed at each point where liquid waste enters the disposal system. The purpose of each trap is to seal off the disposal system so that odors from it cannot enter the plant. The trap is effective only when sufficient water remains in it to constitute a seal. As the water passes through the trap and down the drainpipe it tends to develop suction which would draw the water out of the trap leaving insufficient water in it to form a seal unless the suction is broken on the effluent side of the trap by venting the drainpipe to the air. Then, as the water rushes down the drainpipe away from the trap, instead of sucking the water through the trap it will draw air from the vent pipe. To be effective the vent in each case is located adjacent to the trap. The individual vent pipes are connected with a larger one which extends well above the roof so that it might discharge any odors without being offensive.

Water wasting equipment, such as meat cook vats, curing vats, cured meat soaking vats, and fat chill vats, is not connected directly with the drainage system. The discharge of liquid waste from such equipment is directed immediately into the drainage system by what is referred to as a "broken connection." This is accomplished usually by having the equipment discharge into a drained, curbed area. The purpose of this is to avoid continuity of the surfaces of the equipment handling edible product

with that of the drainage system and furthermore should there by any stoppage in the drainage line, the wastes would not back up into and contaminate the equipment and the product contained in it.

The final disposal of liquid waste as it leaves the packing plant involves two considerations. The first has to do with the reclamation of the large amount of fat from the liquid wastes before they enter the sewage system. The second involves the disposal of the entire sewage which originates in the plant and on its premises and includes that from the sanitary system.

Catch-basin.—This term is usually used to refer to the equipment which has for its primary purpose the salvaging of fat from liquid wastes. Incidentally, it also settles out a large portion of the solids.

The sanitary lines do not empty into the catch-basin, but combine with the effluents of the catch-basin to constitute the total sewage of the plant.

The type of catch-basin depends on the size of the plant and the character of the waste. It should have a capacity for about a ten minute maximum flow and be designed for a velocity of about 4 to 5 feet per minute. The catch-basin is designed to retain floating material which consists principally of the fat to be salvaged and to provide for continuous removal of the material which has settled to the bottom. The catch-basin is located in the open air outside the plant and should be uncovered. Experience has shown this to be practicable even in cold climates.

The floating material is skimmed off regularly into water-tight containers in which it is taken to the inedible rendering department. The area around the catch-basin is paved and drained; a hose outlet facilitates ready cleanup.

The catch-basin is equipped with a device which moves the materials that have settled to the bottom to one end of the tank from which they are removed periodically during the day. This way the settlings are removed before they decompose and do not cause an objectionable condition.

The catch-basin is completely emptied and cleaned out thoroughly each day following the plant operation.

Sewage.—The sewage from meat packing plants presents a disposal problem because of the large flow, seasonal variations in volume of operations, high peak production, strength of wastes, high temperature of the wastes and their disagreeable odor. Because of this, many meat packing plants are prohibited from emptying their sewage directly into the municipal sewage system or into rivers or streams.

Meat packing plants therefore commonly provide some facilities for the treatment of sewage before the liquid wastes of the plant are permitted to enter the local sewage system, rivers, or streams. As this equipment relates to the environmental sanitation of the plant, it has a bearing on meat hygiene. The location of facilities and the disposal of sludge are the principal factors in this connection.

The sewage treatment facilities are located some distance from the plant and are so constructed and maintained as not to create a nuisance. They generally consist of a series of settling basins and tanks for chemical treatment of liquid waste, the object being to have the liquids clear as they are finally discharged and with a biochemical oxygen demand not higher than the requirements of the local sanitary officials.

The removal and disposal of sludge is accomplished without creating objectionable odors or a fly-breeding nuisance. This means that it must be properly digested and promptly dried.

Outside Premises.—Sanitation in a meat packing plant can be influenced by the condition of the surrounding premises. The meat as it is prepared and handled in the plant is exposed to the outside elements through open windows and from areaways and loading docks. Any air-borne odor or contamination which may result from an unsatisfactory condition of the outside premises would interfere with the sanitary handling of the product in the plant. In this connection meat packing plants are not located adjacent to industries which give rise to objectionable odors such as chemical manufacture, for example.

All roadways servicing the plant are paved with a hard surface that will not produce dust as traffic passes over them.

Railroad sidings servicing the plant are paved where the meat is loaded in or unloaded from railroad cars. In addition to being paved so that the motion of air will not create an atmosphere of dust at the loading areas, the railroad sidings are also drained so that they may be washed down and cleaned thoroughly at regular intervals.

Loading Docks and Areas.—Since the entire production of meat and meat food products of the meat packing plant is handled through the loading docks and areas, these places are so constructed and equipped as to maintain clean conditions under which edible product is handled. The docks are covered so that the product is protected in all kinds of weather. The surface of the docks and loading areas is paved with concrete or other impervious material with drains so located as to facilitate regular cleanup. Conveniently located hose outlets are provided for this purpose. The overhead rails used for conveying carcass meat are at least 7 feet high so that the meat will hang sufficiently high above the floor to avoid contamination. Lavatories are provided so that truck drivers and loaders may cleanse their hands when necessary before handling unpackaged meats.

Docks for handling inedible materials are completely separated from docks where edible product is handled. The inedible product dock services the inedible product department exclusively. This dock and its approaches are also paved, drained and supplied with clean-up facilities.

Livestock Pens.—Unpaved and improperly drained livestock pens can create a real nuisance on the premises. Furthermore, to avoid holding animals under unsatisfactory conditions the pens are of sufficient number and size to accommodate the peak load. All of the pens and runways from the livestock unloading platform to the slaughtering department are paved with some such impervious surface as concrete. These areas are also curbed and pitched to drains so that after the solid debris has been picked up and carted away, the entire area can be washed down thoroughly. The drains are usually located immediately under the water troughs in each pen so that splash from the trough will flow immediately into the drain and not create a nuisance as it would if it were allowed to flow across the floor of the pen. Sufficient hose outlets are provided throughout the pen area for convenience in washing down the floor of each pen at the end of each day's operations. It is a common practice during the summertime to

spray with water truckloads of livestock upon their arrival at the plant before unloading. In such cases a paved and drained area is provided where the spraying is done so that the waste water will be confined and conducted directly to a drain.

Rodent Control. This is a continuing problem in a meat packing plant. The location of the plant and the kind of products handled on the premises predisposes infestation with rats and mice. The filthy and dangerous character of rodent contamination of meats intended for human food makes it imperative that rats and mice be eliminated completely from inside the meat packing plant.

There are three kinds of rats: the brown rat (Rattus norvegicus), the black or ship rat (R. rattus rattus), and the Alexandrian or roof rat (R. r. alexandrinus). The last two are subspecies of the R. rattus which occur only in comparatively limited areas, chiefly at seaports in the Gulf States. The brown rat, or house rat, is the one most commonly known and it has no subspecies.

Brown rats may be black and have other variations in color and they also vary in size. These variations give the impression that there are a number of entirely distinct species occurring during an infestation of brown rats. This rat is known by various names depending upon the locality or environment in which it is found and on the size and color of the rats making up a local infestation. They are sometimes called barn, wharf, sewer, gray, and Norway rat.

The brown rat first made its appearance in the United States around 1775. They were first introduced at the various seaports where the rats gained foothold in the United States and gradually spread inland until now they infest every State in the Union.

As the house rat is entirely dependent upon food and shelter provided by man, its spread into new territory followed the migration of people. Its spread into high mountainous areas and extremely dry areas progressed comparatively slowly. Though entrenched in some of the larger towns in Colorado and New Mexico by 1890, it did not reach Wyoming until about 1919 and Montana until 1923.

The brown rat thrives best in the temperate zone where it has almost completely replaced the black rat, but in the Southern States, particularly in Florida and in the southern parts of the States bordering on the Gulf of Mexico the black rat has held its own and predominates in some places.

The brown rat may be distinguished from the black rat by its relatively large size, more robust build, shorter, thicker ears, and shorter tail which, when bent forward, does not reach the tip of its nose, whereas that of the black rat extends considerably beyond. The rather soft fur of the brown rat is usually a greyish brown, fading to a dirty silver grey or pale yellowish white on the belly. Individuals may vary in color from an almost pure grey to reddish-brown or nearly black. Partial albinos are not rare.

The average adult weight of the brown rat is about $\frac{3}{4}$ of a pound. Individuals weighing 1 pound may be considered unusually large. The average length of the adult is 16 to 18 inches including the tail which is 7 to $7\frac{1}{2}$ inches long. The number of young in the litter of the brown rat varies from 6 to 22, the average being 9, or, in the North Temperate Zone, prob-

ably 10. The number of litters produced in a year is reported to vary from 3 to 12. The young are blind and hairless at birth, but grow rapidly and breed when only three or four months old. The life span of a rat is probably between three and five years. Abundant evidence demonstrates that the house rat breeds every month in the year, and there is one record of 7 litters in 7 months from a single pair. The number of litters under average conditions, however, probably varies from 3 to 6 a year. The period of gestation is considered to be twenty-one to twenty-five days. The nests, built of scraps of paper, rags, grasses, or any other soft material, are placed in underground burrows or under floors, wood piles, or any other structures or accumulations that afford shelter near an available food supply.

The brown rat is naturally a burrowing rodent. At times, it may be found in open fields and particularly along ditch banks and water fronts, by far the greater number live in burrows under or adjacent to buildings or within man-made structures. Although not physically adapted for extensive burrowing, the rat is communistic in its mode of living, and cooperation in extending underground runways sometimes results in an extensive maze of tunnels interspersed with nest chambers, though the burrows rarely extend downward more than 18 inches. As many as 281 rats have been taken from a single system of burrows under one small chicken house.

The brown rat is an expert climber, although in this respect it is not equal to the black rat, which lives largely in the upper parts of buildings and in trees. Although frequently found in the upper stories of buildings, the brown rat goes there for the most part only on foraging expeditions and retires during the day to the lower floors and basements or to its burrows under the floors. It is also an excellent swimmer and does not hesitate to take to the water in cases of necessity. It is extremely quick but is not able to run so fast as some other rodents of the same size.

Because of the close association of rats with man and domestic animals and because rats are scavengers living on both filth and edible foods, frequenting alternately sewers and places where food is prepared and handled, privies and larders, running from places where disease organisms abound to places where otherwise sanitary conditions would prevail, carrying the disease organisms on their feet and in their fur and stomachs, they play an extremely important role in the spread and dissemination of disease. Not only do they serve as mechanical carriers of disease but a number of their own diseases are transmissible to man. The rat is also subject to certain human diseases which it acquires and disseminates. Rat-borne diseases are bubonic plague, typhus fever, spirochetal jaundice, rat-bite fever, tularemia, rabies, trichinosis, and food poisoning.

Unless the places in which rats are living are destroyed and potential habitations broken up, control methods are rarely successful. Rats can always find enough food available to sustain life. As long as a place to hide and rear young is available they will continue to survive. Studies have shown that after a poisoning campaign the rat population will regain its former numbers within about nine months or less if no further control measures are under-taken.

Food and shelter are the two most important factors in a rat's existence. It hunts for a food supply and for a convenient harborage nearby. When these two attractions are eliminated the premises lose their appeal to rats. If they are ignored new rats will appear as fast as the old ones are killed off. A successful control program incorporates four major phases: elimination of rat harborages, elimination of food supply for rats, rat-proofing of buildings, and destruction of rats. A program incorporating these controls must be continuing to be successful.

The brown rat commonly lives underground, beneath stored materials, between double walls, and in other similar enclosed spaces. Until such harborages have been eliminated or made unavailable, other control measures will give only temporary relief. All burrows are broken up. Stored materials are placed on racks 12 to 18 inches off the ground. Piles of rubbish and discarded material are not allowed to accumulate. Spaces between double walls are made unavailable by rat-proofing.

Cement, hardware cloth of $\frac{1}{4}$ inch or $\frac{1}{2}$ inch mesh, and sheet metal of 26 gauge or heavier are all good rat-proofing materials. The exterior of buildings is examined for any openings larger than $\frac{1}{2}$ inch which must be closed if rats are to be kept out. Wooden sills and doors at ground level are sheathed in sheet metal to prevent their being gnawed. Windows less than 4 feet off the ground where brown rats are present and at any height from the ground where the climbing rats are prevalent are screened with hardware cloth. Foundation walls, particularly where utility lines enter the building are pointed up with cement.

Where rats burrow beneath a foundation to enter a building, a curtain wall in the shape of an "L", 2 feet deep and 1 foot across the footing is provided. Rats will drill down 3 or even 4 feet but rarely will they cut around the footing. In the case of open buildings such as barns and sheds, it is largely a matter of making certain that no harbor is present so that if a rat does run through the building it will have no place to hide.

Dumps, if not properly maintained provide an excellent rat harborage. Rats can be eliminated from dumps by using a bulldozer to grade and tamp down the material as it is placed on the dumps. Old dumps can be made rat-proof by first smoothing off the surface with a bulldozer and then covering the dump with 3 feet of clean dirt.

Outside premises of the packing plant are kept free of all debris. Refuse is hauled away daily. Unused or obsolete equipment is not permitted to accumulate on the premises to serve as a harbor for rodents.

With the destruction of places in which rats can live and their potential habitations broken up, control measures aimed at destroying rats with the use of bait and traps are successful. The most efficient means of effecting wholesale destruction of rats is the use of poisons. Poisons that are deadly for one warm-blooded animal, however, are also more or less poisonous to others. For use in a packing plant the poisons best suited are those which can be used by the average person without difficulty and which are the least toxic for man. The ones best suited for use in rodent bait are red squill, and ANTU. For use as a fumigant, hydrocyanic acid gas is the most effective.

Baits.—Baits are made sufficiently solid and hard so that they cannot

be broken up and scattered about, or are made soft and placed in a dish or other receptacle protected by a box or cage in which openings are sufficiently large for the rats to enter but not large enough to permit removal of the dish. Baits are not placed in departments where edible products are handled or prepared until after operations have been ended for the day. Strict account is kept of the location and the number of baits set out. All uneaten bait is gathered up and destroyed before operations are begun the next day. Because of the way meat is handled and stored in dry-salt cellars, baits are not placed in these departments.

Rats are omnivorous; that is, they will eat almost any kind of food. Like human beings, some individual rats have definite preferences which must be catered to, but, generally speaking, bait materials consist of cereals, meats, fish, cheese, fruits, and vegetables. Often a change in the kind of food offered will produce greater success. If the rats have been eating poultry feed, baits with a meat or a fish base may yield the best results. On the other hand, occasionally rats will refuse to touch a food they are not accustomed to eating. More important than the materials used, however, is proper preparation of the baits. Too much poison in the mixture is just as faulty as too little, for acceptance will be cut down. If the poison is not thoroughly mixed with the bait material, some parts of the bait will have too strong a concentration, while others will have too weak a one to produce results.

Bait material in small lots, up to a pound or two, can be mixed readily with a large spoon or paddle in a mixing bowl, pail, or similar container. Articles used in mixing poisons are used for that purpose only and kept separate from all other utensils. They are labeled "POISON." Only enough bait for use on the same day is mixed at one time. Baits are most acceptable when fresh.

Of greater importance than the kind of bait used, is the proper placement of the material. Rats seek shelter and protection in their movements as far as possible. Baits placed in rat travelways and harborages are far more likely to be found and sampled than those exposed in the open. Baits should be placed under cover whenever possible. An old board or a box can be leaned against a wall to cover a runway. A permanent bait station for exposing the poisoned baits can be made from an inverted box with two 2 by 3 inch holes cut in each end. This has the added attraction of providing harborage when trash piles or other rat shelters are cleaned up. In any event, baits should be placed where rats are and where they are moving, and not merely scattered anywhere at the convenience of the person distributing them.

Of equal importance is the distribution of enough bait. It is better to put out more than is strictly necessary. Baits should be made into small balls about the size of a walnut or a marble. Care to prevent the odor of the hands from remaining about the baits or the station need not be taken, as rats are familiar with human scent. Sometimes it may be desirable to wrap the baits in a small piece of tissue or waxed paper. This can be done simply but cutting the paper into 4-inch squares, then folding one square over each bait and twisting the ends. This will keep some baits fresh over a longer period. It also provides a convenient means of handling dry

bait mixtures, and affords greater protection to other animals. The main objection to this method is that the rats will often carry the torpedoes, as they are called, back to their nests but will not eat them.

Red Squill.—Red squill is obtained from the bulb of a lily-like plant that grows in the Mediterranean region. It has the peculiar advantage over other poisons of containing an emetic agent that causes vomiting in most animals other than rats and thereby the poison is eliminated. Furthermore, it has a disagreeable taste, so that many animals will not touch it. Nevertheless, it is a poison and should be treated as such.

Red squill, as imported, lacks uniform toxicity and often may prove to be an unreliable rat poison unless it has been brought up to uniform strength by an extraction process. Purchasers should insist upon obtaining red squill that has a guaranteed minimum toxicity not to exceed 500 mg (500 milligrams of the toxic element to a kilogram of body weight of the rat). The most satisfactory results are obtained when the poison is mixed with the bait material in the proportion of 1 to 9; that is, the resulting mixture should contain 10 per cent red squill. When dry cereal is used as the base, the red squill should be added to the dry ingredients and the mixture stirred thoroughly before water is added. When meat or fish is used, a thin paste of red squill and water is prepared, care being taken to avoid lumping, and this is then blended with the bait material.

ANTU.—ANTU is the abbreviated name for the chemical alphanaphthylthiourea, which is highly toxic to the common brown rat, but much less so to the black and other forms of climbing rats. For this reason ANTU is not recommended for general use in areas in which the climbing rats predominate, as in the Southern States. ANTU is a greyish-white powder, insoluble in water, chemically stable, and non-irritating to the skin of human beings. It kills rats by causing an accumulation of body fluids within the chest cavity, literally drowning the animals.

Dogs and other pets, pigs, and day-old chickens are easily killed by ANTU. Although many other domestic animals are more resistant to this poison, all precautions should be taken to prevent children, pets, domestic animals, or foodstuffs from coming in contact with it.

Most effective results are obtained when ANTU is used in food baits in a concentration of $1\frac{1}{2}$ per cent. It is essential that a complete coverage be made when baiting with this poison. Rats receiving less than a lethal dose build up a tolerance as well as a strong dislike for the material. Operations with ANTU should not be conducted at intervals of less than four to six weeks. Hence, in a permanent control program in which ANTU is used, it should be alternated with some other effective rodenticide.

Poisons which are not considered suitable for use under conditions prevailing in meat packing plants are phosphorous compounds, sodium fluoroacetate (compound 1080), and thallium sulphate which are highly toxic substances.

Fumigation.—Control of rats by means of poisonous gases includes the fumigation of buildings and structures, and the gassing of burrows. The fumigation of buildings requires considerable preparation and special techniques. It should be attempted only by persons trained for such work. In many areas the use of poisonous gases is controlled by local regulations.

The gassing of rat burrows out-of-doors is an excellent means of control. Many rats are destroyed underground, so there is no problem of the disposal of the carcasses. Gas has the advantage over poisons of destroying the flea and mite parasites as well, a factor of considerable importance in controlling the spread of some diseases.

The gas most commonly used in rat control is calcium cyanide, in a dust or finely powdered form. It is easily expelled by means of a foot, or stirrup pump, designed particularly for the purpose. The nozzle of the hose is inserted in the burrow, the rest of the opening sealed with earth, and 5 or 6 strokes of the pump handle provide the initial distribution. If gas is seen escaping from other holes, these, too, should be sealed, or the rats will escape. The valve on the bottom of the pump is then switched over to "air," and the gas is forced through the entire burrow system. Burrows that have been gassed should always be broken up with a pick or a shovel the next day and the earth tamped down tightly. The remaining rats will reopen the burrows, and these can thus be detected and retreated until all activity ceases. Extreme care must be taken in handling all cyanides since they are very toxic for man.

Carbon monoxide, introduced into rat burrows by means of a hose attached to the exhaust of a gasoline motor, has also been used with a fair degree of success. About five minutes running time to a burrow will usually suffice. As carbon monoxide is not so swift acting as calcium cyanide, it requires more gas and longer time to take effect.

Carbon dioxide, in the form of dry ice, has been found useful in fumigating refrigerated warehouses where low temperatures must be maintained to prevent food spoilage. The ice is crushed and distributed through the room. An electric fan will speed up the dispersal of the gas. Carbon dioxide is used in about 15 per cent concentration, or 30 pounds to 1,000 cubic feet of space, for twenty-four hour exposure. It has the advantage of being much safer to handle than the highly toxic forms of gas.

Other types of poisonous gases are not recommended for general use in rat control.

Rat Viruses.—So-called rat viruses are not used in meat packing plants inasmuch as the organisms used belong to the same group as those that produce food poisoning and their use cannot be subjected to adequate control. The so-called viruses are supposedly capable of starting an epidemic among the rat population. This method of destroying rats has rarely proved effective. Rats killed by eating the infected food must be eaten by other rats in order for the disease to be passed on. The sale of rat viruses is prohibited in some localities.

The House Mouse.—House mice have a long breeding season. The gestation period is twenty-one to twenty-four days, and the average number of young, born blind, hairless, pink, and helpless, is 5. They become independent of the mother in about three weeks and are sexually mature in two to three months. The mother breeds three to six weeks after a litter is born and ordinarily has from 5 to 8 litters a year.

The usual length of life is fifteen to eighteen months, but individuals may live as long as six years. Their breeding potentialities considered, it is easy to understand why, under favorable conditions of weather and

food, there have been great plagues of mice. The last great mouse plague in the United States was at Buena Vista Lake, California, in the fall and winter of 1926–27.

This little rodent has keen senses, with the exception of that of sight. It is good-natured and curious; climbs, jumps, and swims well, although it rarely goes into water. House mice readily adapt their ways of living to changing environment. They generally follow regular lines of travel that they have established.

Mice are kept under control in the meat packing plant by eliminating all harbors and by trapping.

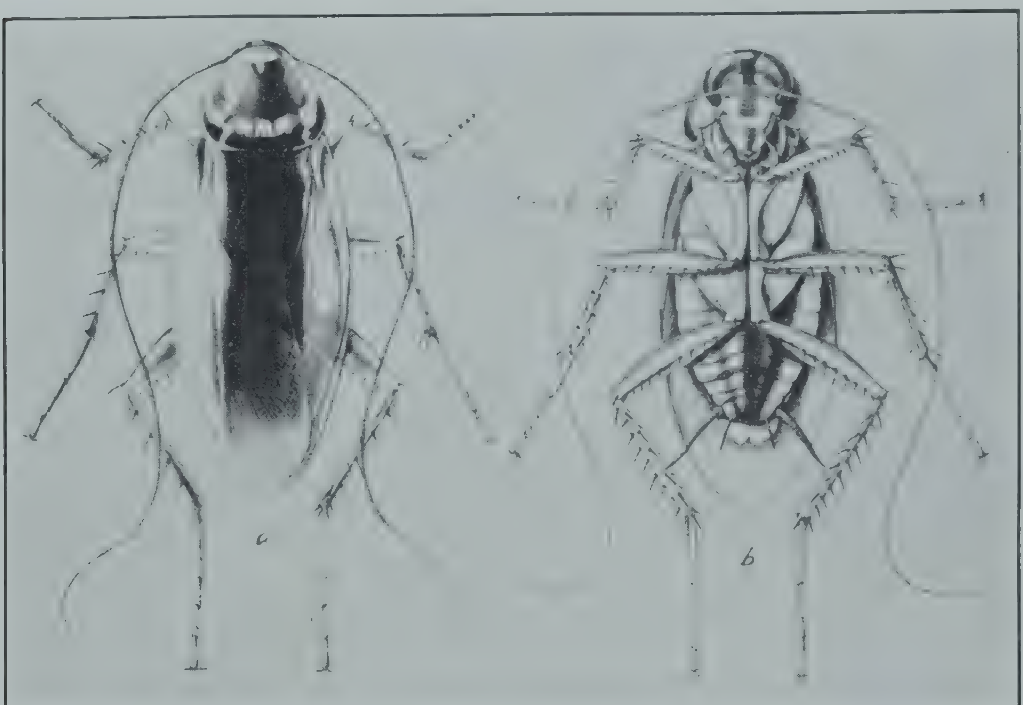


FIG. 31.—The American cockroach: *a*, View from above; *b*, from beneath.

Insect Control.—Insect infestation and the preparation and handling of edible products are not compatible. Insects breed and feed on filth as well as on food prepared for human consumption. They contaminate foods with which they come in contact both with their excrement and foul material adhering to their bodies and appendages. Food may also be contaminated with the bodies of dead insects.

Insecticides are so used that they cannot in themselves contaminate edible products and the use of those having a residual action must be such as to avoid dead insects falling into edible product as it is being processed. There are two classes of insecticides in this connection; the one has a so-called "knockdown" action, the other has a continuing residual delayed action. Those with the residual action are not used in departments where edible products are prepared. In such departments the insecticide with an immediate or "knockdown" action is employed during the periods when meat processing operations are not in progress. This permits the insecticide

and dead insects to be completely removed from the department by a thorough clean-up prior to the starting of the meat processing operations. The insecticides with delayed or residual action are excellent for use in departments where there is no exposed meat such as the outside premises, the inedible products departments, pens, loading docks, dry storage rooms, toilet rooms, dressing rooms, and offices. In any case, the use of insecticides must be accompanied with the elimination of places where the insects may breed and hide.

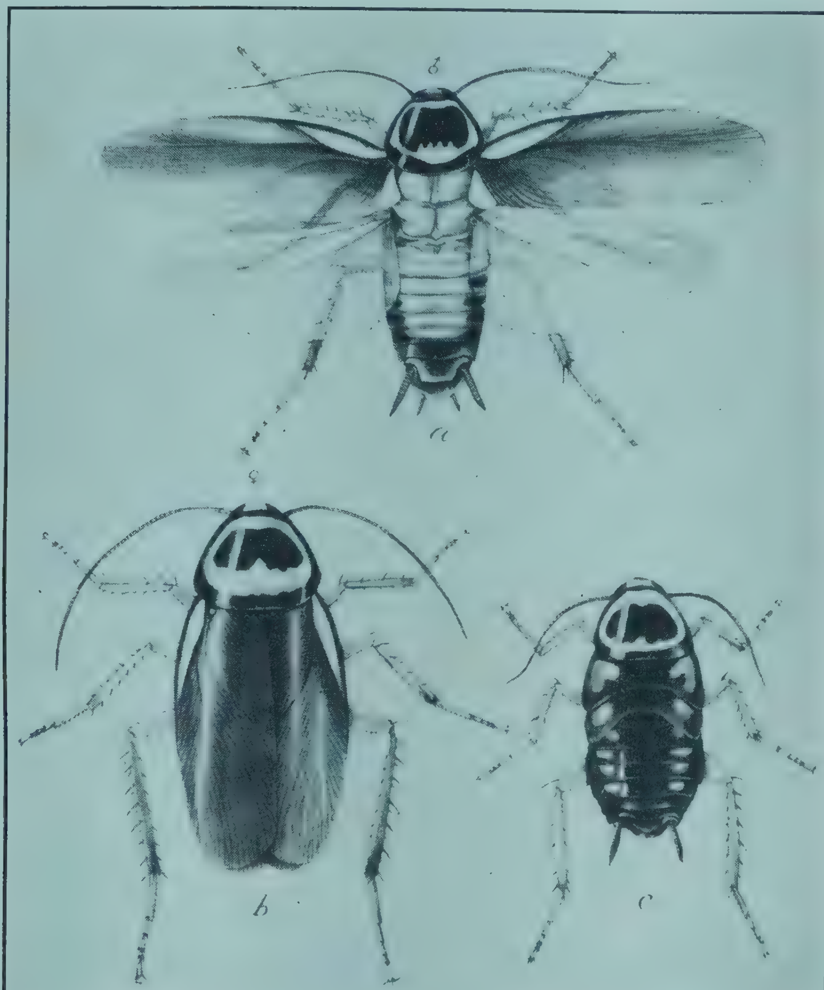


FIG. 32.—The Australian cockroach: *a*, Male with wings spread; *b*, female; *c*, nymph.

Cockroaches.—Five kinds of cockroaches are encountered in America. The American cockroach (*Periplaneta americana L.*) is the largest; it is from $1\frac{1}{2}$ to 2 inches long when full grown. It is light-brown. All of the adults have long, powerful, reddish-brown wings.

The Australian cockroach (*Periplaneta australasiæ F.*) resembles very closely the American cockroach but is seldom more than $1\frac{1}{4}$ inches long and is easily identified by a bright-yellow heavy line on the outer edge of the basal half of the wing.

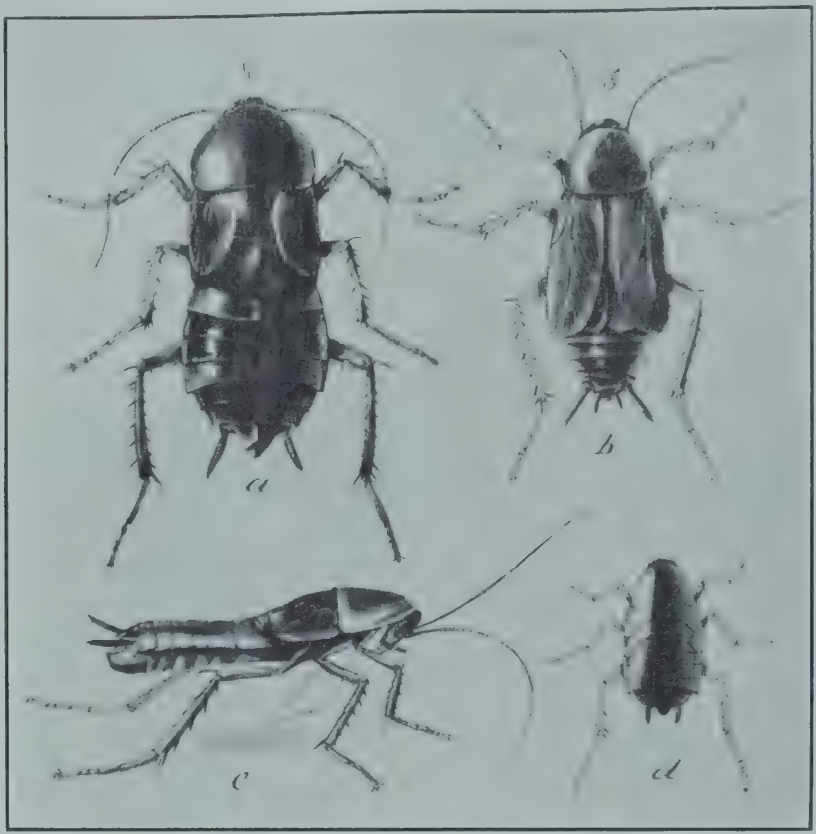


FIG. 33.—The oriental cockroach: *a*, Female; *b*, male; *c*, side view of female; *d*, half-grown specimen.

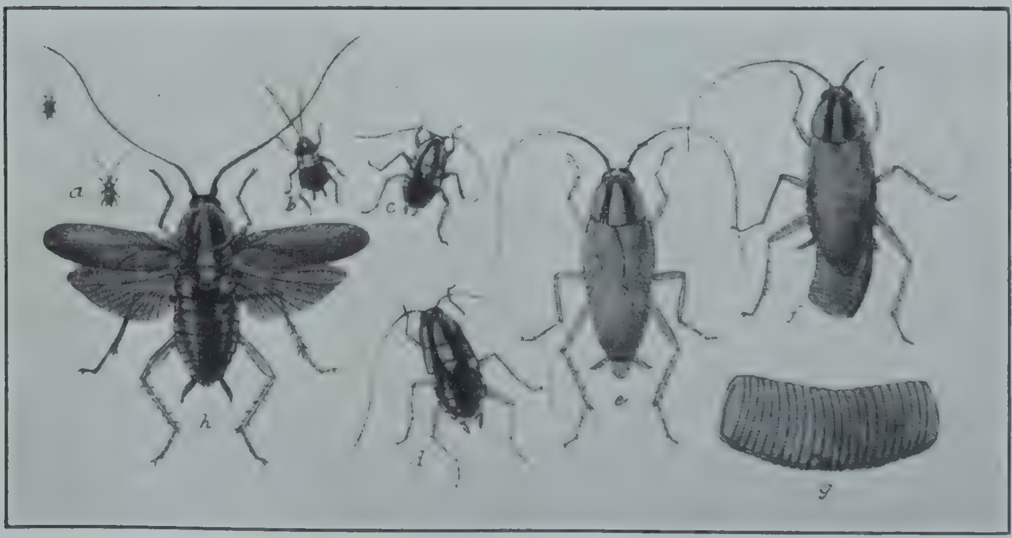


FIG. 34.—The German cockroach: *a*, First stage; *b*, second stage; *c*, third stage; *d*, fourth stage; *e*, adult; *f*, female with eggs; *g*, egg case (enlarged), *h*, adult with wings spread.

The oriental cockroach (*Blatta orientalis L.*) or "black beetle" is entirely black or dark brownish black attaining a length of about $1\frac{1}{4}$ inches. Of all the cockroaches it is the most sluggish in its movements and thrives best in very damp places. The female is almost wingless and cannot fly.

The German cockroach (*Blattella germania L.*) "croton bug" or "water bug" is one of the smallest roaches, measuring up to $\frac{5}{8}$ of an inch long. It is light-brown and is marked on the back between the head and wings with two dark parallel stripes. The wings are of uniform light-brown color.

The tropical cockroach (*Supella supellecticium Serv.*) infests the cities of the Gulf Coast region. It is slightly smaller than the German cockroach, many females being only $\frac{3}{8}$ of an inch long whereas the male is about $\frac{1}{2}$ inch long. The females have bodies much broader than the males and wings that are reddish-brown; the wings of the male are much lighter. Both sexes are distinguished from the German cockroach by two cross-bands of bright yellow, one at the base of the wings and the other about $\frac{1}{16}$ of an inch further back.

FIG. 35.—A tropical cockroach: *a*, Female; *b*, male.

The cockroach lays its eggs in leathery capsules which the female carries for several days partially extruding from her body. She often glues these capsules finally to some object, but sometimes merely drops them unattached about the places she frequents. The capsules of the croton bug and of the tropical cockroach which are hardly $\frac{1}{4}$ of an inch long often contain from 25 to 30 eggs. Roaches of all species are very small when hatched but so resemble the broad and flattened shape of the parent that they can be identified easily as cockroaches. It is only after they reach maturity that the wings develop. The cockroach develops rather slowly and is capable of subsisting under unfavorable food conditions for long periods. As a result, roaches in all stages of growth are usually present at the same time. The German roach may pass through two or three generations a year but most roaches require about one year to become mature.

Cockroaches are nocturnal in habit. They hide during the day in

shelters or darkened places where they congregate in large masses. They forage at night when all is still and dark. If disturbed while foraging, they run rapidly for shelter. Knowledge of where they conceal themselves is usually the key to their control.

Cockroach elimination is not difficult if the sources of infestation can be controlled. This contemplates elimination of shelter for the cockroach within the meat packing plant, and in mild climates control measures are extended to the surrounding premises. Roaches may develop outdoors in mild climates and from there crawl into or fly into a meat packing plant.

The departments in which exposed meats are processed and handled are examined thoroughly for cracks and crevices which might shelter cockroaches. All such places are eliminated. Rooms, such as toilet and dressing rooms and rooms used for dry storage are kept clean and free of debris which might harbor the cockroach and then these rooms are treated regularly with insecticides. The insecticides most commonly used for the effective control of cockroaches are sodium fluoride, DDT (dichlorodiphenyltrichloroœthane), and chlordane. DDT and chlordane are not used in departments where exposed meat is processed and handled. These insecticides have a residual action which would carry over and be effective during the period when meats are being prepared and handled creating the danger of dead insects falling into and contaminating the edible product. Sodium fluoride is used in edible products departments after the processing operations are completed and all exposed meats are removed from the room. A thorough cleanup completely removes the sodium fluoride and dead roaches before the processing of meats is resumed.

DDT and chlordane are used in dry storage rooms, toilet rooms, and dressing rooms where their continuing action produces effective control. Also, these insecticides are effective when used to treat outside premises and inedible products departments of the meat packing plant.

Flies.—*Housefly* (*Musca domestica L.*).—This fly lays its white eggs in masses on the breeding media. It seems to have certain preferences, but will breed freely on any excrement and decomposed material. The eggs hatch in from ten to twenty-four hours and the larvæ or maggots feed on the material on which the eggs are laid and reach full size (about $\frac{2}{3}$ of an inch long) in from four days to several weeks depending on temperature. When full grown the larvæ move away from the moist parts of the breeding material to comparatively dry surroundings. Here they pupate. The pupæ are yellowish to dark-brown, depending on their age, and are barrel-shaped. The pupal stage lasts from three to six days in warm weather and may last many weeks in cold weather. When transformation is complete, the adult fly pushes open the end of the pupal case, works its way to the surface and expands its wings until fully developed and dry. The female mates and is ready to lay eggs in from two and one half to twenty days after emergence. From 2 to 21 egg masses, each containing about 130 eggs may be deposited by 1 female during a normal lifetime of from two to twelve weeks. The adult fly takes food for the most part in liquid form, but flies can ingest minute objects and are known to ingest eggs of parasitic worms.

Blow Fly.—Several species of the larger, green and bluish colored flies with metallic sheen and also some grey-colored blow flies are encountered on the premises of meat packing plants. Blow flies breed mainly in carrion although some will breed in excrement, especially of man and hogs. They will breed in garbage, particularly if it contains meat or meat wastes. They also deposit eggs ("blow") on either raw or cooked meat.

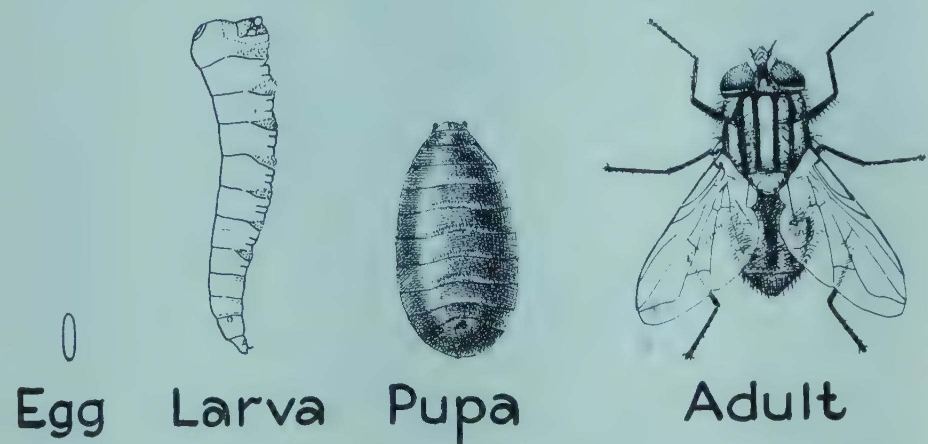


Fig. 36.—House fly.

Fig. 37.—Ham skipper—adult fly.

The eggs of the blow fly hatch in from six to forty-eight hours, the growing larvæ feed on the breeding media for from three to nine days after which the full-grown larvæ leave the food and bury themselves in the loose earth. The pupal period lasts from two to seven days under favorable conditions

after which pupation takes place. The pupal period varies considerably according to temperature. The life history of the blow fly requires from sixteen to thirty-five days under favorable conditions. The life of the adult averages about thirty-five days.

FIG. 38.—Ham skipper—well grown larvæ.

FIG. 39.—Ham skipper—puparia.

Ham Skipper (Piophila casei L.). The adult is a shiny black fly about $\frac{3}{16}$ of an inch long. It is characterized by the position of its wings which extend laterally at right angles to its body. It gets its name from a characteristic of its larvæ which infests hams and has the ability to bring both

ends of its body together and to suddenly hop or jump a distance of 3 or 4 inches. The adult lives on an average of about three or four days during warm weather and deposits about 140 eggs. The tiny, white eggs are scattered over the surfaces of exposed meats, especially cured and smoked pork, but may also infest cheese. They hatch in about twenty-four hours at 80° to 90° F. The larvæ or maggots are white and may become full

Fig. 40.—Ham beetle: A, Adults; B, larvæ.

grown in five days when they are about $\frac{3}{8}$ of an inch long. Another five days may be passed as a pupa in the puparium which is about $\frac{5}{16}$ of an inch long. The life cycle from the laying of the egg to the emergence of the adult may require only fourteen days, and two generations a month in warm weather are common. Reproduction proceeds actively between 56° and 120°F.

Beetles.—*Ham Beetle* (*Necrobia refipes De Geer*).—This is a small, shiny, bluish-green beetle with black eyes and with the legs and the first

five segments of the antennæ of a reddish-yellow color. It is not more than $\frac{1}{4}$ of an inch long. The adult beetle may live fourteen months during which time individuals have laid as many as 2,100 eggs. These eggs are scattered over the surfaces of meat. In warm weather, incubation of eggs may require only four days. The larvæ is elongated about $\frac{3}{8}$ of an inch when well grown which takes about seventeen days. When about to be transformed to the pupal stage, the larva constructs a white paper cocoon from droplets of a frothy material emitted from its mouth. About thirteen days after constructing the cocoon, the adult emerges. The life cycle from the laying of the egg to the emergence of the adult may be completed in as few as thirty-four days in warm weather.

Larder beetle (*Dermestes lardarius L.*).—These are robust, brownish-black beetles distinguished by a broad, yellowish-grey band across the basal portion of their wing covers. The adult is a strong flier during warm weather or in a heated room. Individuals have lived from three to seven months and they lay several hundred eggs. The eggs are scattered on cured meat and particularly dried meat products. The incubation period for the eggs is from three to eight days during warm weather. The larvæ are $\frac{1}{2}$ inch long when well grown, grownish in general color, with a lighter-brown stripe running lengthwise along the center of the back. They are white underneath and have two rather short but distinct spines on the rear near the end of the body. There are also conspicuous long, blackish spines on the body. It requires from three to four months to pass through the larval stage. It is seldom that a generation can mature in less than three months under favorable summer weather.

Ham Mites. (*Tryoglyphidae*).—These 8-legged meat infesting mites also attack cheese and are tiny, soft-bodied creatures, almost colorless, which appear on the product as whitish spots. They multiply fast and molt frequently.

Control.—The prevention of insect breeding is the most important consideration in insect control. The outside premises of the packing plant are kept free from accumulations of all vegetable and animal material which may decompose and serve as breeding media. Sewage disposal systems are watched closely to detect fly breeding places. Sludge, especially if not properly treated and dried, may provide excellent breeding material. Heavy scum if permitted to accumulate on settling tanks and sludge drying beds provides ideal breeding conditions.

Daily cleanup throughout the meat packing plant eliminates insect breeding places. All openings in buildings are protected with well-fitted screens. The screens are at least 16 meshes to the inch so as to exclude all sizes of insect pests. Ceiling fans installed over entryways aid in keeping out insects.

The use of flytraps is an important adjunct in the ordinary procedure in the prevention of fly breeding. Huge numbers of house flies and blow flies may be caught in properly constructed and properly baited traps set at strategic locations. The traps are set where flies naturally congregate. The conical-type trap as shown in figure 145 has been found to be the most effective and easily handled. The trap is from 12 to 18 inches in diameter, the sides and top built of screen with a cone reaching nearly to the top.

The bait is placed beneath the trap in a broad shallow pan about 4 inches less in diameter than the base of the cone and 1 inch deep. The bait pans are kept well-filled and are washed out regularly. Flies are not permitted to pile up in the trap since this reduces its efficiency.

Despite every effort to prevent insect breeding, some insects will be produced. In many cases, screening and trapping do not prove to be adequate control measures in themselves and it is necessary that they be implemented with the use of insecticides.

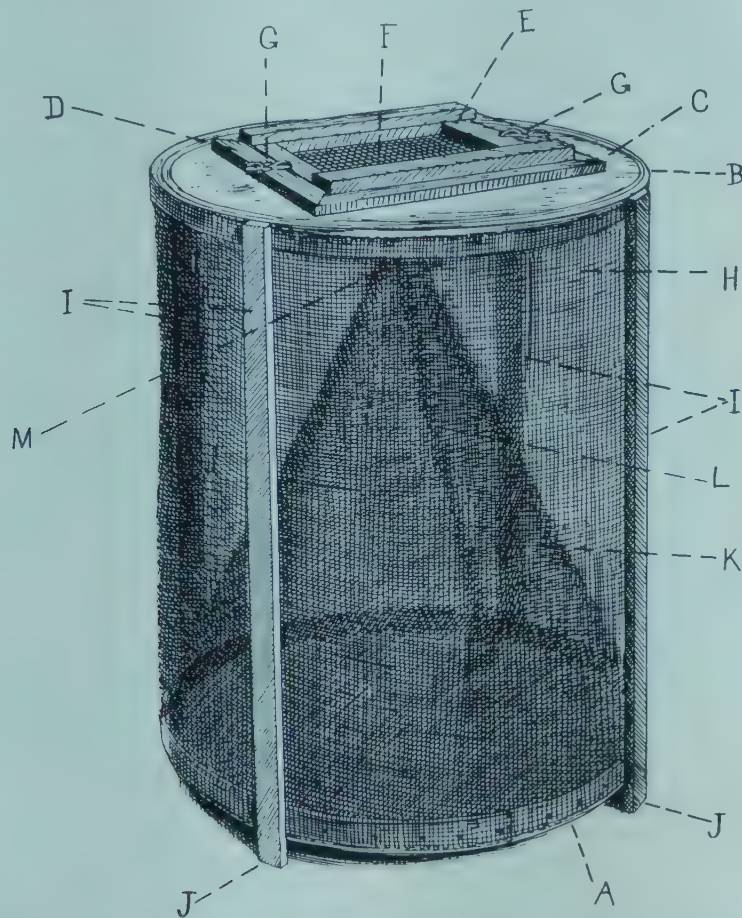


FIG. 41.—Conical hoop flytrap, side view: *A*, Hoops forming frame at bottom; *B*, hoops forming frame at top; *C*, top of trap made of barrel head; *D*, strips around door; *E*, doorframe; *F*, screen on door; *G*, buttons holding door; *H*, screen on outside of trap; *I*, strips on side of trap between hoops; *J*, tips of these strips projecting to form legs; *K*, cone; *L*, united edges of screen forming cone; *M*, aperture at apex of cone.

Packinghouse Employees.—At many points in the various stages of handling and processing incident to preparing meats and their products for human food, employees of the meat packing plant come in close and frequently in direct contact with food articles. Packinghouse employees are an important element in the environmental sanitary control in the plant.

A program of employee education and training in the importance of personal cleanliness and the maintenance of clean working conditions is part of breaking in a new employee for work in a meat packing plant. He is also given the facilities to aid him in his personal cleanliness.

Most local jurisdictions have laws that require certification as to health of people who work in food handling plants. These laws usually require periodic health examinations. Complete reliance is not placed on such health examinations in meat packing plants in which inspectors are located. The inspector is on the alert for those cases where an employee shows some indication that he or she may be affected with a contagious disease in the communicable stage. When an employee is suspected of being affected with such a condition, he is required to obtain a physical examination and certification from the examining physician that he is in fit condition to handle food before being permitted to continue in the employment.

The inspector is constantly on the alert for conditions involving the hands or arms of an employee that would be a probable source of contamination for meat which the employee handles. Open sores are particularly dangerous because frequently the bacterial infection involves the same organism that produces food poisoning. Open sores on any exposed part of the body are a probable source of contamination.

Nail polish is another offender. The working conditions tend to loosen nail polish and particles flaking off contaminate the food product. Both sexes are required to wear a headdress that is adequate to prevent falling hair from contaminating the food.

Only washable outer garments are worn by packinghouse employees and these are changed and laundered frequently. The employee's outer garments are laundered for the employee either by facilities maintained on the premises or by an outside service. It has been found necessary that the employee be furnished with this laundry service to assure a supply of clean outer garments when necessary.

Hand washing facilities are placed at many locations throughout the plant. It is imperative that the employee be able to wash his hands should they become soiled before he again handles any food product. The hands are washed in running water from a combination faucet which blends hot and cold water to a temperate degree. The flow of water is controlled by a foot-valve. The foot-valve is preferred to a hand valve since operating valves with soiled hands creates an unclean condition. The faucet discharges the water at a point of approximately 12 inches above the bowl so that the hands and arms may be washed freely without obstruction. Liquid soap is provided in a dispenser that does not become contaminated through repeated use by soiled hands.

Employees' dressing rooms are supplied with abundant natural light and good ventilation. They are separated from adjoining toilet rooms by tight, full-height walls or partitions, and solid, self-closing doors completely filling the doorway opening. Generally, employees are provided with individual lockers for their clothes and other personal belongings. These are made of metal. A locker space is at least $15 \times 18 \times 60$ inches. The lockers are about 16 inches above the floor and supported in a way that permits easy and complete cleaning of the floor underneath. It is preferred that lockers not be placed against walls but rather back to back with adequate passageway between the lockers and the walls and between double rows of lockers. The lockers placed back to back have a single back partition in common. This avoids space which would serve as harborage for

insects. When it is necessary to place lockers against a wall the metal locker back is eliminated entirely and the wall serves as the back of the locker. This also avoids providing a harborage for insects. Adequate lavatories and showers are provided. The lavatories are located in the dressing room immediately adjoining the doorway from the toilet room.

Facilities where employees may eat their lunches are provided either as part of the dressing rooms or as a separate lunch room. Such facilities are necessary so that the employees will not eat their lunch in the meat processing departments. Many insanitary conditions can result from converting meat processing departments into lunchrooms.

Only water closets and urinals are located in the toilet rooms adjoining the dressing rooms. In toilet rooms located throughout the meat packing plant, lavatories are provided in addition to water closets and urinals. Water closets are provided in sufficient number for the number of employees at the plant at the ratio of 1 unit for each 25 men or 20 women.

Toilet rooms are not entered directly from a workroom but through an intervening dressing room or toilet room vestibule. The doorways in the toilet rooms, dressing rooms and toilet room vestibules are provided with solid, self-closing doors completely filling the doorway openings. The floors of toilet rooms and dressing rooms are of impervious material and pitched about $\frac{1}{8}$ inch per foot to floor drains. If stall-type urinals are provided, the nearby floor is pitched to drain into the urinals. If the urinals are of the wall type, a floor drain is placed under the urinals and adjacent floor is pitched to the drain.

Drinking fountains are available in all dressing rooms and operating departments. They are particularly important in meat processing departments since, in their absence, employees would drink from any available outlet which in many cases would be connected with equipment in which edible products are handled. An employee drinking water from an outlet situated over a vat in which cured hams were soaking, for example, may result in water from the employee's mouth and face contaminating the hams in the vat.

Cleanup.—Cleanliness in the meat packing plants depends on a great many things. It is influenced by the surrounding in which the meat packing plant is located, the type of construction of the packing plant, the plan of the plant as it relates to volume and kind of meat packing operations, the kind of equipment used and finally, the facilities for cleanup and the cleanup program in the particular plant. Refuse is not permitted to accumulate either in departments of the meat packing plant or on its premises. The frequency of refuse removal depends on the need but it is removed at least once daily.

Outlets for cleanup hoses are located with sufficient frequency throughout the plant that an abundant supply of water is available in all departments where meat is handled and processed. The outlets are numerous enough so that the use of long hoses can be avoided. Long hoses constitute an interference with the movement of traffic throughout operating departments and may cause unclean conditions to develop. Wire brushes and steel wool are not used in cleaning equipment on which meat is handled. Their use might result in contaminating food with wire or particles of steel.

An abundant supply of hot water is essential to adequate cleanup in a meat packing plant. It is necessary to remove the grease and particles of fat that become lodged on floors, walls, and equipment. Devices for mixing cold water and steam at hose outlets for the production of hot water have not proved satisfactory. Hot water is delivered at outlets usually at a temperature of 140° to 150°F. from a central hot water system. When hot water is used for disinfecting purposes its temperature may then be boosted by steam to at least 180°F.

Equipment Washroom.—Although cleanup is a progressive practice in the meat processing departments while operations are under way, the washing of equipment adjacent to exposed meat creates an unsatisfactory condition through the contamination of the food by cleanup water splashing into it from the equipment being washed. Accordingly, equipment washrooms are provided in which specialized facilities are installed for cleaning certain kinds of equipment and adequate floor space is provided for cleaning trucks, vats, racks, and the like.

Curing equipment, such as hogsheads and boxes in which bacon is cured, after being emptied of its contents in the curing department is taken to the equipment washroom where it is thoroughly cleaned, and in many cases, sterilized with hot water at 180°F. after which it is returned to the curing cellar and put into use again.

Metal molds used in the preparation of cooked hams and many kinds of meat loaves present a difficult cleaning problem. They are cleaned with equipment provided with revolving brushes rotating in a strong alkali solution; then they are placed in equipment which thoroughly rinses them in sprays of hot water.

Smokesticks from which many kinds of sausage and pork products are hung for smoking are cleaned thoroughly between each batch of smoked product. These are cleaned in the equipment washroom where they are placed in a drum containing a strong alkali solution and then rotated. After this treatment they are rinsed thoroughly in clean, hot water. Gambrels are handled in a similar manner each time they are used.

Trolleys from which carcass meat is suspended in the coolers require special attention. Not only do the hooks become soiled but the trolleys themselves become corroded. It is necessary to remove the corrosion from the trolley at the same time the soilage is cleaned from the hook. Otherwise rust from the trolley would drop on the meat and soil it as the meat on trolleys moves on the rail from the slaughtering department to its destination in a processing department or the shipping dock. An effective system for cleaning trolleys consists of a series of tanks into which the trolleys are dipped. They are usually dipped into these tanks in batches up to 100 and more suspended from a rack. The batch is first lowered into an alkaline cleaning solution heated to a temperature of 180°F. It is allowed to soak for about five minutes and is then lifted out of the tank and permitted to drain before being placed in the next tank which contains fresh rinse water also heated to 180°F. This rinsing can be accomplished just as effectively by using a high pressure hose discharging water at approximately the same temperature. After being rinsed, the trolleys are lowered into a third tank which contains the derusting solution. A wooden tank is

used for this purpose; the solution consists of one of the mildly acid detergents. This solution is also held at a temperature of 180°F. and the trolleys are held in it for a sufficient period to remove the rust, which is usually from five to ten minutes. When all rust and corrosion are removed the trolleys are raised, allowed to drain, and taken to a second rinse tank where they are thoroughly rinsed in fresh, hot water to remove completely any trace of acidity. The final step is a dip in a tank of hot paraffin oil held at about 160°F. Sometimes a small amount of wax is dissolved in this hot paraffin oil to give the trolley a better protective coat. When the trolleys are removed from this tank the hot paraffin and dissolved wax drain off readily, leaving only a very thin coating which is sufficient to protect the surface from rust while awaiting re-use and during their use in the coolers.

Frequently, secondhand shipping containers, usually slack barrels, are reconditioned and cleaned thoroughly for use again as containers of meats. Those that show signs of having been so handled previously as to preclude their being used again as food containers are rejected and removed from the plant along with other refuse. Those that are susceptible of being placed in proper condition are taken to a washroom where mechanical equipment is provided that thoroughly scrubs the container both inside and outside with a strong detergent solution. The container is thoroughly rinsed and disinfected with 180°F. water and then, after drying, presented for inspection before being used.

Corrosion of cleaned metal surfaces of food handling equipment sometimes occurs between the time that it is thoroughly cleaned and when it is again used for handling food. To avoid this corrosion, a thin film of an odorless, tasteless, and colorless mineral oil is applied to the clean metal surface after the equipment has been thoroughly cleaned. Care is exercised to see that excess mineral oil is wiped from the surface with a clean cloth before the equipment is used for handling meats.

Detergents.—Detergents are surface-active agents and include a large number of substances that come under the three general headings of soaps, alkalies, and synthetics. An effective detergent has good wetting properties which completely wets the material constituting the soil and penetrates between that material and the soiled surface. It lowers the interfacial tension between the soil and the solution in which the detergent is dissolved, lifting the soil from the soiled surface. Then, with the mechanical action of agitation and flushing, the soil is removed. Soap is an excellent detergent, but it has the undesirable property of depositing a scum in hard water. The addition of alkalies to soap keeps in suspension the precipitates making up the scum and greatly extends the usefulness of soap. Many of the synthetic detergents have in themselves this combined property of wetting and suspending the soilage without forming a scum. The alkalies include silicates, phosphates, carbonates, and hydroxides. There are a great many synthetics including alcohol sulfates, alkyl aryl sulfates, alkyl sulfonates, sulfated and sulfonated amides, sulfated and sulfonated esters, sulfated and sulfonated amines, and quaternary ammonium compounds.

Acid cleaners, such as sodium bisulfate and monosodium sulfate, are useful in connection with the removal of rust from metal surfaces. Their

use is limited to this purpose since they are not effective for general cleaning. Detergents possessing an odor which is not readily removed by rinsing are unacceptable. Only moderate amounts of rosin soap are used in cleaning mixtures since larger amounts usually impart an odor to the object. Borax, sulfites, and oxalic acid are not used in cleaning mixtures. These materials are excluded from the meat packing plant because they are potentially food adulterants.

Disinfectants.—Equipment that has become contaminated with diseased material is first cleaned thoroughly in a place specifically provided and is connected directly to the sewer. Then the equipment is disinfected by subjecting all of its surface to thorough flushing with water heated to 180°F.

Disinfection of other equipment is not commonly practiced. However, a meat processing department and food handling equipment in the department sometimes become contaminated with an organism that withstands the most thorough cleaning practices. It is necessary then to disinfect all surfaces of the equipment and the floors, walls, ceilings, and other exposed surfaces. Aqueous solutions of quaternary ammonium compounds, sodium hypochloride or chloramine are used for this purpose. They are only used, however, after removal of all meat from the room or compartment. Their use is not a substitute for thorough cleaning. In fact, their effectiveness is considerably reduced if the surface on which they are used is unclean.

The strength of the solution of quaternary ammonium compounds customarily does not exceed 1 oz. of a 10 per cent aqueous solution or 1/10 oz. of the dry material to 4 gallons of water. The concentrated solutions and the dry chemical are handled with care because they are extremely irritating to the mucous membranes. The solution of sodium hypochlorite or chloramine customarily used contains $\frac{1}{2}$ of 1 per cent available chlorine (5,000 parts per million). Disinfectant solutions are allowed to remain on the equipment until it is again used when the residue is thoroughly rinsed from all surfaces that may contact food. The residue is permitted to remain on the floors, walls, and ceilings where it may exercise a continuing action.

Steam usually referred to as live steam does not have in practice that sterilizing value which it would appear to have in theory. As live steam is discharged from a pipe or hose it very quickly loses its pressure and its temperature drops sharply. Within a very short distance, a matter of a few inches, the steam has turned to merely a warm vapor. The temperature of steam can be best used for disinfection purposes by discharging it into water already heated to a temperature of approximately 140°F. The steam will boost the temperature of the water readily to a disinfecting temperature of 180°F.

Equipment.—Equipment used in the packinghouse for the handling and preparation of meat and its products is so constructed and maintained as not to constitute a source of contamination for the food. Furthermore, it is so installed as not to interfere with the maintenance of clean conditions in the surrounding area. The equipment is constructed of material that presents a smooth, impervious surface free from crevices, seams, or joints

in which food may lodge, decompose, and support the growth of organisms. All parts of the equipment are accessible for cleaning. The equipment is so located with respect to fixed objects, such as floors, walls, pillars, and other pieces of equipment, to permit ready and thorough cleanup following the day's operations.

Wood is not a satisfactory material for use in constructing equipment for handling meat or its products. Its surface does not remain smooth, neither is it impervious. Nevertheless, it is necessary to provide a wood surface where meat cutting is done. Cutting blocks are used for this purpose and constitute a removable part of equipment the remainder of which is metal.

Enameled surfaces, although smooth and impervious, are not satisfactory for meat handling or processing equipment, since particles of the enamel easily chip off and may contaminate the food. Painted surfaces on equipment are even more objectionable since they are less permanent and the paint readily contaminates the food.

Copper at one time was a favorite material for use in making kettles since it lent itself nicely to the metal worker's art. Also, many pipe fittings have been and still are made of copper. Copper is not a satisfactory surface for food-handling equipment since it discolors the food in some instances, contaminates it with its salts, and tends to catalyze fat deterioration. Copper kettles are acceptable for use after being tinned on their inside so long as the tin coating remains intact.

Tin coated metal surfaces are satisfactory for food handling equipment as are those coated with zinc (galvanized). Galvanized metal equipment is the more popular of the two; however, both coatings wear off and must be replaced from time to time. As the coatings wear off, the unprotected steel or iron surface cannot be kept clean and sanitary because of a rapidly progressive corrosion that occurs under packinghouse conditions.

Some use has been made of plastics to coat metal surfaces. Properly applied synthetic resin lacquers have been found to work satisfactorily when applied to the surface of metal equipment that is used for certain purposes. These resin coatings have not proved to be useful on meat trucks and similar equipment that is customarily subjected to hard usage and frequent contact with metal tools. Vinyl coatings have been found too soft and phenolic coatings too brittle.

So-called stainless steel is the most satisfactory material with which to construct equipment for the handling and processing of meat and its products. Its surface is bright, smooth, and impervious, and it approaches complete resistance to atmospheric corrosion. It is a chromium and nickel alloy of iron. Several such alloys are made, each for a particular purpose. The alloy containing approximately 18 per cent chromium and 8 per cent nickel with a carbon content below .15 per cent is the one best suited for meat handling equipment. Chromium is the only alloy which has been found to produce in iron alloys a metal with a surface completely resistant to atmospheric corrosion. At least 11 per cent of chromium is necessary to accomplish this effect. The addition of nickel in substantial proportions to the chromium-iron system provides a series of alloys with more pronounced resistance to many kinds of corrosive attack, and at

the same time introduces important advantages with respect to the physical or mechanical properties of the metal. These alloys have higher tensile strength than have ordinary steels of the same carbon content. The one containing 18 per cent of chromium and 8 per cent of nickel that has been found best suited for meat packing house use is non-magnetic and extraordinarily tough and ductile. When proper precautions are followed this alloy will weld without brittleness either by the acetylene, electric arc, or resistance process.

Vats of many kinds are used in meat packing plants. Generally, they are made of metal and are so located and constructed that they can be readily and thoroughly cleaned. Concrete vats have not worked out satisfactorily where the concrete surface is exposed to fats. Fat causes deterioration to set in, the surface of the concrete disintegrates and loses its smooth finish, resulting in a pitted surface which cannot be kept clean.

Chutes.—Chutes are used for conveying many types of product from one level to another. They are made demountable so that they can be taken down in segments of convenient size for cleaning, and where they go through the floor the opening is surrounded by a heavy metal flange extending at least 8 inches above the floor level. The segment of the chute which fits into this flange is also removable for cleaning. Chutes that connect edible products departments with inedible products departments are hooded at the edible end and vented to the outdoors. The product enters the hooded end through a self-closing trap door. This prevents passage of odors from the inedible products department to the edible products department.

Mechanized equipment of many descriptions, such as meat choppers and agitators over fat rendering kettles, requires attention to avoid contamination of food from grease and particles which might drop into it from the overhead gears or motors.

Racks are used in many departments both for dry storage and for storage of edible products. These are at least 12 inches above the floor and of such size that they can be readily taken to the washroom for cleaning.

Many kinds of valves are used in pipe lines that convey food products. These are demountable for cleaning and so constructed that there are no dead spaces in which food may stagnate and decompose.

There are three general classes of containers in which meat and its products are placed and handled. They are: the so-called operating container which is used to transfer meat from one department to another in the meat packing plant, the so-called shipping container which is used to ship wholesale lots of meat from the plant to the trade, and the true container which is generally the consumer package. The operating container used within the plant is of the same construction as other product-handling equipment. That is, it is one that will stand up under hard usage and keep in a condition which will permit its ready and thorough cleaning. The shipping container is of such construction that it will protect the product under the usual conditions encountered through shipment to the trade. These are usually lightweight wood or cardboard containers of many kinds. The principal interest is that the material from which these containers are constructed will not contaminate the product

packed therein. The paper lining that is frequently used in such containers is of a quality that will not disintegrate and contaminate the food. Sometimes the printing on true containers is not fast and may run and contaminate the food in the container. Attention is given to see that the kind of material from which the true container is made as well as the printing on it is such that the product in the container will not become contaminated enroute to the consumer.

Bursting electric light bulbs, broken window glass, and broken light globes are sources of serious contamination of food with broken glass. All broken window glass is immediately replaced as are broken light globes. All exposed electric light bulbs are protected so that, if broken, the pieces will not drop into any meat or its products.

Slaughtering Department.—Because of the nature of the operations performed and the large volume of material handled even in a small slaughtering department, the construction of the department, its arrangement, and its facilities influence significantly the sanitation surrounding the conversion of animals to meat. The walls and floors are impervious and smooth so that they may easily be cleaned. The floors are pitched to drains so located that cleanup may be continuous and progressive during the slaughtering operation without any danger of contaminating the meat at any stage of its preparation. The overhead structures are so arranged and constructed that they can be readily kept in a clean condition.

The handling of the many kinds of product that are produced incident to the slaughtering and carcass dressing operations is accomplished without resulting in congestion in the department. In large slaughtering departments this is done by providing chutes that convey the various classes of products from the locality where they are produced through the floor of the slaughtering department to other departments where they receive further handling. In slaughtering departments of relatively small capacity where chutes are not used for conveying the products of the carcass dressing operations, adequate passageway is provided for the movement of hand trucks and other containers used for removing these products from the slaughtering department to the other departments.

The movement of the thoracic and abdominal viscera from the point of evisceration to the place where they are separated into their edible and inedible parts is best initiated by using a "moving table." This moving table consists of an endless chain of flights for cattle viscera or pans for the viscera of small stock. This equipment removes the viscera automatically from the point where evisceration is conducted to the place where the separation operations commence. Viscera inspection is also conducted on this table. As the flights or pans discharge the viscera and return, they are thoroughly cleaned and disinfected by flushing with water at 180°F.

Cattle.—Whether the animal is shackled after knocking which is the common practice for cattle not slaughtered as kosher, or without knocking which is the kosher practice, adequate facilities for restraining the animal are provided. Complete restraint of the animal is of utmost importance so that it may not escape into the slaughtering department. An animal loose in the slaughtering department where the carcass meat is exposed

during the various stages of the dressing operations results in the contamination of a considerable amount of meat.

Sufficient space is allowed for bleeding so that blood will be confined to the bleeding area. This area is pitched $\frac{1}{4}''$ to the foot to 2 drains. One drain is the blood line which conveys the blood to the inedible department. This is at least a 4 inch line and it is provided with a running U trap which prevents odors from the inedible department passing up the blood line into the slaughtering department. At least a 3 foot drop is provided above the trap to maintain the flow of the blood which tends to coagulate. The other drain is connected with the sewer system and is provided with a cover which is closed except during the cleanup. When the bleeding area is flushed with water as part of the progressive cleanup during the slaughtering operation, the blood line is closed and the water passes down the drain which is connected with the sewer.

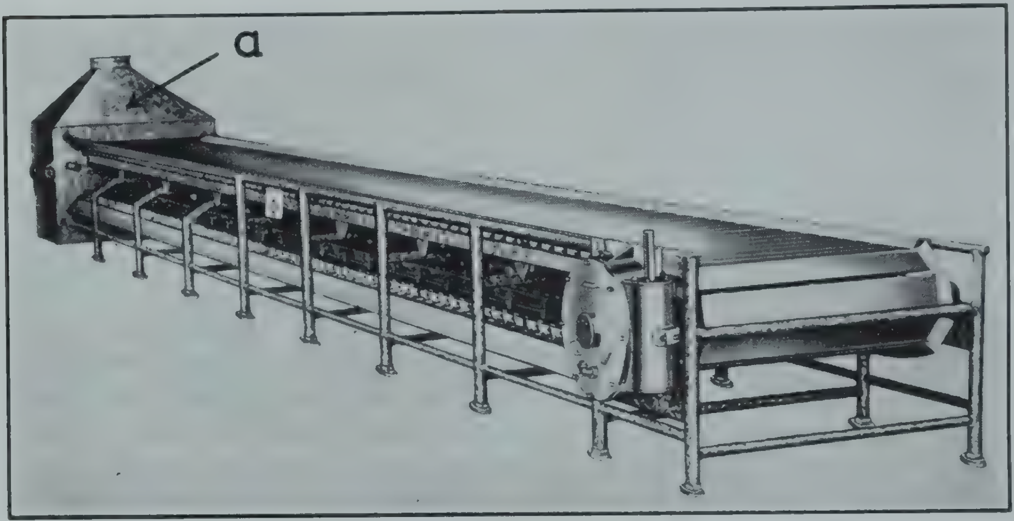


Fig. 42.—Flight top "moving table" for conveying and inspection of cattle viscera: *a*, Disinfecting cabinet.

A lavatory and sterilizer is provided at the point where the head is removed from the carcass so that the employee who removes the head may wash his hands and disinfect his knife to prevent the carrying of contamination from one head to another. Facilities are provided so that the head as it is removed from the carcass and prepared for inspection may be handled individually to avoid one head contacting another until it has passed the inspection. Facilities are provided for removing the horns and the pieces of skin which are sometimes left on the head when it is skinned. The equipment used for removing the horns can be readily cleaned and disinfected to avoid carrying contamination from one head to another. Equipment for washing the heads individually is also provided. This usually consists of a cabinet closed on three sides to control the wash water, the head is suspended from a hook where it is washed thoroughly using water under pressure.

The floor pitches both ways from the area in which the carcass is laid for the initial skinning and opening operations. Metal plates having a grilled

upper surface and imbedded in the floor have been used extensively to anchor short metal rods that prop the carcass in position for skinning the ventral surface. These "pritch" plates sometimes become loose and a foul condition develops in the space beneath them and the floor. The plates are then taken up and reset to make them tight-fitting. Cradles consisting of a pipe frame in which the carcass is laid for skinning have come into use. These cradles are moveable, and being of pipe construction they are easily cleaned. Their use, furthermore, avoids the installation of the pritch plates and the floor, therefore, is more easily cleaned.

A lavatory and sterilizer is conveniently located for use of the employees who perform the initial skinning of the carcass and conduct the other dressing operations on the carcass as it lies in the cradle. The feet and dewclaws are removed at this position and a container is provided for them in which they are removed from the department.

A lavatory and sterilizer is also provided at the half-hoist position to which the carcass is moved from the dressing bed. The evisceration is performed here and the eviscerator may carry contamination from one carcass to another unless he is able to thoroughly clean his hands and arms and disinfect his equipment. The floor is pitched from the position where the carcass is located on the half-hoist to a floor drain. A cleanup hose is provided at this point with facilities to furnish water at temperatures ranging up to 180°F. should it become necessary to disinfect the area due to contamination which might occur incident to the evisceration.

As the carcass is raised to the rail on which it travels to the cooler, the hide is completely removed. A chute is provided for the prompt removal of the hide from the slaughtering department. Any attempt to load cattle hides on trucks for removal from the slaughtering department is avoided inasmuch as such handling of the hide creates an unsanitary condition.

FIG. 43.—Chart showing minimum distances allowed for equipment and operations to assure cleanly handling of beef carcasses during the dressing operation. Rail heights are measured from the top of the rail to highest part of floor.

Description	*Vertical Distances*
Bleeding rail (distance from rail to point of application of shackle to shackled foot—48″)	16′ 0″
Dressing rails (trolley length—15″)	11′ 0″
Beef cooler rails (trolley length—15″)	11′ 0″
Rails for beef in quarters (trolley length—15″)	7′ 2″

Description	*Horizontal Distances*
Dry area in front of knocking pen	5′ × 8′
Curb of bleeding area to pritch plates (no header rail)	5′ 0″
Line of drop-offs to line of half-hoists (2 beds)	16′ 0″
Line of drop-offs to line of half-hoists (3 beds or more)	18′ 0″
Line of half-hoists to header rail leading to cooler	14′ 0″
Between header rail and carcass washing rail, if parallel	6′ 0″
Between header or washing rails and wall of slaughtering room	3′ 0″
Between center lines of dressing beds	8′ 0″
Between pairs of dressing rails	4′ 0″
Between moving top table and dressing rail at inspector's platform	5′ 6″
Area for sterilizing viscera inspection truck	7′ × 8′

The area in which the carcasses are washed as their final handling before entering the cooler is pitched to a drain and enclosed to avoid the splashing of wash water from one carcass to another.

Calves, Sheep, and Goats.—A mechanical hoist is used to convey the shackled animal to the bleeding rail. When the animal is shackled from an elevated platform it is thrown to the platform as part of the act of shackling; this results in additional soilage of the head and shoulders. When the animal is shackled and is elevated by a mechanical hoist from the floor level, it is immediately raised from a standing position to the bleeding rail without any contamination from the floor of the pen.

The bleeding area is drained similar to that described above for cattle. As the carcass proceeds on the dressing rail, any drip from it is caught in a depressed and drained area in the floor. The surrounding floor area is pitched to this depressed and drained area under the rail. By this arrangement the cleanup of the floor is facilitated.

A lavatory and sterilizer is provided both where the head is removed in the case of calves and where the carcasses of three species are opened for evisceration. Again at the point where the carcasses are eviscerated a lavatory and sterilizer is available for use by the employee who performs the evisceration.

At those positions where the carcasses are washed, the area is enclosed and drained for control of the wash water.

Following are vertical and horizontal distances used in slaughtering departments for calves, sheep, and goats that contribute to the maintenance of clean conditions during the dressing operation:

FIG. 44.—Chart showing minimum distances allowed for equipment and operations n calf, sheep and goat slaughtering departments to assure cleanly handling of carcasses during the dressing operation.

Description	*Vertical Distances*
Bleeding rails for calves (distance from top of rail to point of application of shackle to shackled foot—30″)	11′ 0″
Bleeding rails if only sheep are slaughtered	9′ 0″
Gambrels or leg hooks from which calf or sheep carcasses are suspended to floor or inspector's foot platform	7′ 3″
Cooler rails, calf carcasses	Gambrels 7′ 3″ above floor
Cooler rails, sheep carcasses on logs	Hooks of logs 6′ 6″ above floor

Description	*Horizontal Distances*
Vertical of rail to edge of viscera inspection stand	2′ 0″
Length of rail from point of evisceration to point where carcass inspection is completed	6′ 0″

Hogs.—The shackling and bleeding of hogs creates considerable dust in the air and is quite noisy. The scalding vat and dehairing machine produce considerable heat and vapors in the surrounding area. These operations, therefore, are segregated from the hog dressing department. This is accomplished either by locating them in a separate compartment

or by using a partition. There is considerable waste water from the scalding vat and dehairing machine that is caught in an area pitched to the drain and directed to the sewer. Hog hair accumulates rapidly in connection with the dehairing operation and facilities are provided for directing this to a chute which removes it promptly from the department.

As the hog carcasses move along the dressing rail they pass over a drained, depressed area to which the floor is pitched. This directs all drip from the hog carcasses and facilitates the cleanup of the department. Lavatories and sterilizers are provided where the heads are dropped for inspection, where the carcasses are opened for evisceration, and where evisceration is actually conducted. All areas where washing of the hog carcasses is conducted are enclosed and drained to control the wash water.

Following are vertical and horizontal distances that are used in laying out hog slaughtering departments for the purpose of maintaining clean and sanitary conditions:

Fig. 45.—Chart showing minimum distances allowed for equipment and operations in hog slaughtering departments to assure cleanly handling of carcasses during the dressing operation.

Description	*Vertical Distances*
Bleeding rail to sticker's platform	10′ 6″
Extension of bleeding rail to top edge of scalding vat	9′ 0″
Dressing rails	11′ 0″
Gambrels (suspending carcasses) to floor (12″ trolleys)	10′ 0″
Distances from rail to bottoms of inspection pans and various foot platforms	See dimensions on attached drawings
Rails in coolers for hog carcasses with heads removed (12″ trolleys)	9′ 0″
Rails in coolers for carcasses with heads attached (12″ trolleys)	10′ 0″

Viscera Separating.—The handling of the thoracic viscera does not present any special problem. Separating it into its various edible parts can be accomplished in a clean manner using tables and conveyors of a construction that can be readily maintained in a clean and sanitary condition. The separation of the abdominal viscera is a more difficult problem principally because of the necessity for taking precautions at each step to avoid contamination of the edible portions with the contents of the digestive tract.

Facilities that are adequate to properly handle the abdominal viscera are provided from the point of evisceration to the final production of edible and inedible products resulting from the separating of the viscera into its various parts. The viscera separating operations are conducted as close to the point of evisceration as is physically possible depending on the rate of slaughter. The flow of operations constituting the separating process is continuous and there is a minimum amount of manipulation incident to the operation. The transportation and manipulation of abdominal viscera with its digestive tract contents can be accomplished in a clean manner only with the utmost of care.

The walls and floor are impervious and smooth. The floor is pitched to drains so located that cleanup is facilitated. A water outlet or outlets are provided depending on the size of the department, for cleanup hose connections.

Cattle.—The cattle carcass is eviscerated directly into a truck in the case of a small slaughtering production or for large production on "a moving table." At the time of evisceration the viscera is separated into four parts: the thoracic portion, the liver, and two abdominal portions. One abdominal portion includes the four stomachs and the other the small and large intestines. The viscera is transported by the truck or moving table to the point where the separation operations commence.

The stomach portion is placed on a table sufficiently large to handle the volume of operations. In no case are the stomachs permitted to accumulate preparatory to handling. The table is large enough to accommodate the number of workmen necessary to handle the particular production. Over the table are water outlets having spray attachments that can be used to immediately remove any soilage which might occur through seepage of digestive contents prior to its evacuation. The caul (omental) fat is removed from the stomach portion and a receptacle is provided for its cleanly handling and transportation to the rendering department. At the same time fat called "seam fat" is trimmed from the surface of the omasum and abomasum. This fat is also handled in a clean manner along with the caul fat. The stomach portion is then separated into a portion consisting of the omasum and abomasum which are discarded as inedible and the portion consisting of the rumen and reticulum are handled as edible. The omasum and abomasum are placed either directly into a chute which conveys them to the inedible products department or in a truck which is used exclusively for inedible products.

The rumen and reticulum are moved to the end of the table where there is a hopper connected directly with the sewer and provided with a water standpipe. The contents of the rumen and reticulum are evacuated directly into this hopper and the emptied stomachs are placed over the standpipe which thoroughly flushes them of their digestive contents. Next, there is provided a metal standard resembling an umbrella in shape and size. The rumen and reticulum which have been thoroughly flushed of their contents are handled as a unit and spread over the convex top of this equipment. They are thoroughly washed on both the peritoneal and mucous sides under a water spray. At this point the portions which cannot be washed clean are trimmed and discarded. The clean rumen and reticulum go into the preparation of tripe.

The intestinal portion of the abdominal viscera is placed on another table which is also equipped with overhead water outlets for use in washing away any seepage of intestinal contents. Here again the table is large enough to accommodate the number of employees necessary to take care of the production without piling up of the viscera. First, the small intestine is removed from the mesenteric fat. Beginning at the duodenal end, the intestine is cut from the fat at its attachment. The loose intestine as it is separated drops to a perforated metal surface over which a spray of water continuously plays. When the employee removing the intestine reaches

the halfway point, he loops the loose end on a conveyor belt which carries the intestine through a stripping machine between two metal rollers. A hopper directly connected with the sewer is provided under the perforated metal tray and as the intestine is carried into the stripper it passes over metal bars which permit the intestinal contents to drop through to this same hopper. In this manner the small intestine is separated from the abdominal viscera and stripped of its contents without contamination and immediate removal of its contents to the sewer.

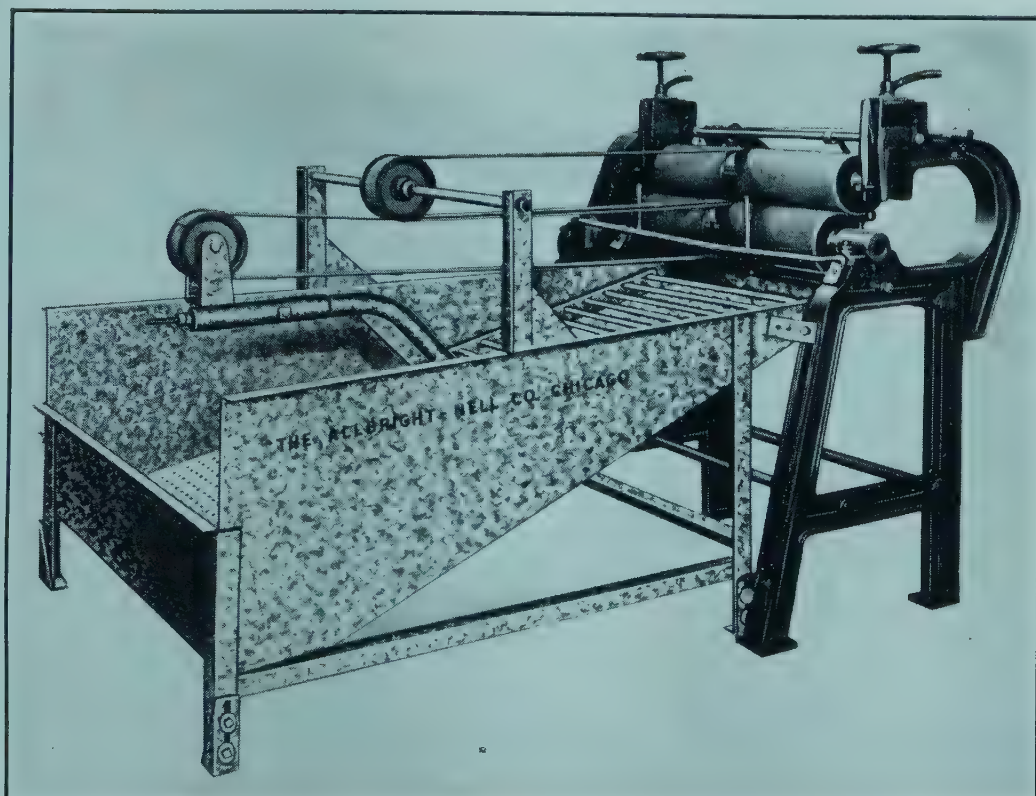


Fig. 46.—Equipment for stripping small intestines free of their contents preparatory to converting intestines to casings.

The cecum is next removed from the abdominal viscera and its contents are thoroughly flushed from it by placing it over a standpipe that discharges water into it.

The remaining portion consists of the mesenteric fat and the large intestine minus the cecum. The lumen of the large intestine is flushed entirely clean of its contents by directing water under pressure into it at one end and discharging the other end directly into a hopper connected with the sewer. The large intestine is then pulled free from the mesenteric fat. After being examined carefully for any possible soilage the mesenteric fat is conveyed to the rendering department.

Calves, Sheep, and Goats.—The viscera is separated into three parts consisting of the thoracic portion with the liver attached and two abdominal portions. The two abdominal portions, because of the contents of their

digestive tract, are required to be handled in such a way that there will be no contamination of the edible portions.

Generally, the only part of the stomach portion that is saved for food is the caul fat. Occasionally the rumen and reticulum of calves, sheep, or goats are saved for human food in which case they are handled the same as the comparable organs of cattle are handled. The abomasum of very young calves is sometimes saved for the manufacture of rennin.

The small intestine is pulled from the mesenteric fat. It is conveyed mechanically through a stripper between two metallic rollers. As the intestines are conveyed to the stripper they pass under sprays of water which wash their contents directly into a hopper connected with the sewer.

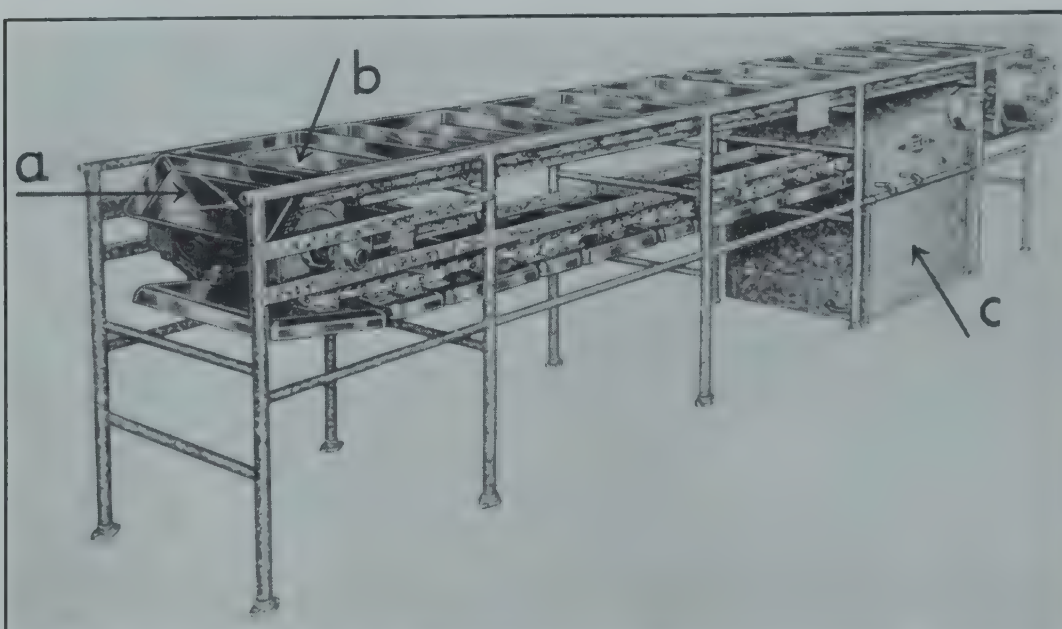


Fig. 47.—Pan type "moving table" for conveying and inspection of hog viscera and hog heads: *a*, Pan for holding the head; *b*, pan for viscera; *c*, disinfecting cabinet.

The large intestines are not usually saved for any edible purpose. The mesenteric fat is removed from the large intestine. This fat is examined for cleanliness after which it is removed to the edible rendering department. The large intestine with its contents is removed to the inedible products rendering department.

Hogs.—The thoracic and abdominal viscera are removed intact from the hog carcass. In a plant of large production, the viscera is carried on a moving table from the point of evisceration to the place where the viscera separation begins. In a small plant, the viscera is first placed in a pan for inspection after which it is lifted to a table for separation into its various parts. First, the lungs are removed and handled as inedible. Next, the heart, liver, and spleen are removed and saved as edible products.

Of the abdominal viscera, the stomach is first removed and immediately emptied of its contents. The stomach is emptied into a hopper directly connected with the sewer and provided with a water standpipe over which

it is thoroughly washed both inside and outside. Each stomach is thoroughly cleaned individually if it is to be saved as an edible product. The caul fat is removed at the same time as the stomach and it is examined thoroughly for cleanliness before it is conveyed to the edible rendering department.

The small intestines are then pulled from their attachment to the mesenteric fat. As the intestine is pulled, it is conveyed directly through a stripper which squeezes out its contents between two metal rolls. The intestine is conveyed to the stripper under water sprays and as the intestine approaches the stripper it passes over bars placed at right angles to the intestine which permits the intestinal contents to drop into a hopper directly connected with the sewer.

When portions of the large intestine are saved for chitterlings, they are flushed of their contents and after being opened for their entire length they are thoroughly cleaned both inside and outside. The terminal portion of the large intestine of larger sizes is sometimes saved for casing manufacture after being thoroughly flushed of its contents. In any case, the large intestine is removed from the mesenteric fat and this fat, after being examined for cleanliness, is taken to the edible rendering products department.

Refrigerating Departments.—Fresh meat is chilled as rapidly as possible and this constitutes the only method of combating spoilage and decomposition that does not change the character of the meat. Other methods of preventing spoilage and decomposition of meat, such as by salting, smoking, or drying, alter its character. The chilling is done promptly and thoroughly to reach a temperature not higher than 32° to 35°F. throughout the meat in what is called the initial stationary phase during which there is no bacterial increase. The refrigeration facilities, therefore, are adequate to handle the maximum meat production for the particular plant. There is refrigerated space available for each carcass immediately after completing the dressing operation and sufficient room in the refrigerated space to permit placing the carcasses so that there may be free circulation of air between them.

Refrigeration.—Mechanical refrigeration has entirely replaced natural ice in the meat packing industry in the United States. There were a few remaining large refrigerated rooms for meat using natural ice until as late as the 1920's. Large quantities of ice were placed in drained waterproof overhead bunkers. Such a bunker would have a high side and a low side. The warm air would rise in the space between the wall of the cooler and the high side of the bunker passing over the top of the side into the bunker where it would be chilled by coming in contact with the ice and the chilled air would drop over the low side of the bunker into the space where the meat was hung. This same air movement occurs where refrigeration coils are in the bunkers.

Mechanical refrigeration is based primarily on the principle that to convert a liquid to a gas requires the expenditure of a definite amount of energy. This energy is in the form of heat. There are two measures of heat, one deals with the intensity of heat, the other with its quantity. Temperature is a measure of intensity and is expressed usually in degrees

Fahrenheit or degrees Centigrade as registered by a thermometer. The quantity of heat is measured by British Thermal Units. A B.T.U. is the quantity of heat necessary to raise the temperature of 1 pound of water 1°F.

It requires heat to melt ice or boil a liquid and change it to vapor. When such change is brought about the necessary heat must be forthcoming from some source. In the case of refrigeration the heat is absorbed from the surrounding objects and, of course, the temperature of those objects is thereby lowered. The heat required to change a liquid into gas is called "latent heat" or internal heat to distinguish it from "sensible" or observable heat. The latent heat required varies with different substances. For vaporizing water it is 970 heat units; for ammonia it is 555 heat units; for sulphur dioxide about 170 heat units.

Liquid anhydrous ammonia under 180 pounds pressure will boil at 95° F., under 100 pounds pressure it will boil at 64°F., under 15.65 pounds at 0°F., and under atmospheric pressure it will boil at minus 27°F. Liquid anhydrous ammonia can be made to boil or vaporize by simply lowering its pressure which is another principle made use of in refrigeration since it must absorb heat when it boils.

Conversely, when ammonia gas is compressed by putting it under increased pressure, its temperature will rise. If, then, while still under pressure its temperature is reduced to a definite critical point by a cooling medium and if its latent heat is extracted, the gas will return to a liquid. This is what happens in an ammonia condenser.

It is possible to use for a refrigerant any substance which exists as a liquid at normal temperature and at either high or low pressure, and which exists as a vapor at low temperature and low pressure. There are a number of substances in use as refrigerants but, for several reasons, anhydrous ammonia is best adapted for most cases and is most generally used commercially.

There are two general systems of ammonia refrigeration, namely, the compression system and the absorption system. In an ordinary compression system of refrigeration the cycle of operations is as follows: Liquid ammonia in the liquid receiver is forced under relatively high pressure through a pipe to a valve called the expansion valve which is located at the entrance to the cooling coils in the medium to be refrigerated. When the expansion valve is partially opened the liquid ammonia is allowed to flow into the lower pressure of the cooling coils, and the ammonia is released of the high pressure, it immediately begins to boil and in doing so absorbs enough heat from the medium to supply the latent heat necessary to vaporize the ammonia. The ammonia vapor thus formed flows at low pressure through the main suction pipe to the ammonia compressor. In the compressor the gas is compressed into smaller volume which raises its pressure and temperature. This hot gas is discharged into the ammonia condenser which consists of a bank of pipe coils over which cold water is showered to cool the ammonia. The water absorbs the latent heat of the hot high pressure ammonia gas and it goes back to the liquid state flowing under pressure into the liquid ammonia receiver completing the cycle.

The absorption system starts the same way with liquid ammonia in the receiver under high pressure. The liquid ammonia is allowed to expand

in the same way in the cooling coils at a reduced pressure. It vaporizes and takes up heat the same as in the compression system. From this point on the operation is somewhat different. The low pressure ammonia gas is drawn through the suction pipe to an absorber in which there is a weak solution of ammonia in water. Here the gas is absorbed in the water, producing a strong solution of ammonia. From the absorber the strong solution of ammonia is pumped to a generator which is a steel cylinder containing steam coils. In this cylinder the strong ammonia solution is heated and the ammonia gas is driven off at high temperature under pressure leaving a weak ammonia solution behind. The ammonia gas is condensed in a pipe coil condenser under a spray of cold water the same as in the compression system and the liquid anhydrous ammonia under pressure returns to the receiver completing the cycle. When the ammonia vapor is being absorbed in the absorber it gives off its latent heat of vaporization and the absorber is kept cool by a circulation of cold water. The weak ammonia solution left in the generator is returned to the absorber to absorb more ammonia gas. In the absorption system the absorber takes the place of the ammonia compressor used in the compression system.

In refrigerating systems in which it is not desirable to expand the ammonia directly in the piping in the coolers, the coils are located in a tank of salt brine, or calcium chloride brine which is chilled to low temperatures and the brine then used as the refrigerant. Salt brine of 1.2 specific gravity will freeze at 0°F. Calcium chloride brine of 1.2 specific gravity will freeze at -10°F. At 1.25 specific gravity calcium chloride brine will freeze at -32°F. and is sometimes used to maintain freezers as low as -25°F.

Brine Sprays.—A high rate of refrigeration is obtained by using a spray of refrigerated brine. Quick chilling is accomplished by rapid circulation of air at low temperatures and this is done efficiently by sprays of refrigerated brine that have a strong inductive action. Their effectiveness is due to the large aggregate surface of the innumerable droplets which make intimate contact with the air through which they move.

Brine sprays are used in unit coolers, overhead ducts or decks, and in vertical side wall chambers. The vertical side wall chambers are used when there is not enough head room available for overhead installations. The brine spray nozzles are located at the top of such a chamber and the spray is directed downward. The air is drawn in through the top of the chamber by the downward motion of the spray and becomes chilled as it passes through the spray and is discharged from the bottom of the chamber.

Brine sprays in overhead installations such as ducts and decks are adjusted so that the spray will not overshoot the duct or deck and pass down into the room with the chilled air. This system is not effective when the ducts are short or the decks are narrow. In any case, the system requires constant attention to avoid the brine spray contaminating meat and to control the corrosion of metal equipment in the refrigerated compartment.

The spray ducts and decks are well insulated. If not well insulated the warm air from the carcasses will strike the lower side of the duct or deck condensing the moisture from the warm air and the condensate will drip

on the meat. This equipment is also carefully waterproofed to avoid leaks.

Because of the difficulty of controlling the brine spray in the vertical side chambers and in the ducts and decks to avoid contamination of meat with brine and the excessive corrosion of metal, this type of refrigeration is gradually being replaced by unit coolers. These coolers discharge refrigerated air at high velocity. This accomplishes an effective chilling of the meat and it avoids the condensation of moisture on the walls, ceilings, and equipment which is usually difficult to control in most refrigrated spaces. These unit coolers operate by blowing air past refrigeration coils in a metal housing. Refrigerated brine is showered over the coils to keep them defrosted and this brine is collected in a reservoir and used again and again. The cooler is equipped to eliminate any brine which might be picked up by the air as it passes the coils and before the air is discharged into the room. The units are made of non-corrosive metal which facilitates their cleaning and they are installed in the vicinity of a floor drain which controls any liquids which might escape during their operation.

Defrosting.—When the refrigeration coils are used as the source of refrigeration in a cooler they require periodic defrosting. This is usually accomplished by turning off the refrigeration and manually removing the accumulated ice from the coils. The meat in the cooler is protected from contamination that might result from this ice falling on it. This is accomplished by having the refrigeration coils when located overhead placed in watertight bunkers so equipped that the accumulation of ice can be removed without passing through the area in which the meat is located and these bunkers are also supplied with drains for carrying off the water from the melted ice. The refrigeration coils are sometimes lined up against the walls of the cooler. In such cases they are placed over a curbed and drained area which confines the ice and drains off the water accumulating from the melted ice.

Carcass Cutting.—The cutting of carcasses into their primal parts is done under refrigeration so that the meat will not lose its chill as it is prepared for distribution to the trade. The rail heights for conveying the carcasses through the refrigerated compartment are the same as those given for the slaughtering department. The rails are cleaned regularly to eliminate any corrosion or any particles which might drop onto and contaminate the meat as it is conveyed suspended from trolleys. The cutting tables and other equipment used for handling the meat are made of rust-resistant metal provided with removable cutting boards. The metal equipment and the cutting boards are of such size as to permit their being easily handled and readily cleaned. The floors are provided with drains so located as to facilitate hosing down the floor periodically, and conveniently located hose outlets are provided for this purpose. Sawdust is not used on the floors in departments where meat is chilled or cut. Sawdust is a source of contamination of the meat with dust raised by the movement of men or meat handling equipment. It also interferes with cleaning the floor by washing.

As the carcasses are cut into their primal parts, meat cuts and trimmings accumulate rapidly. Sufficient equipment for handling the products of the

meat cutting operation is necessary and adequate floor space for the equipment is provided.

Small containers of hot water are provided to free the butchers' knives of accumulations of fat. These containers require attention to maintain them in a clean condition and the insulation of the steam pipes used to heat the water is protected to avoid its becoming soiled and grease soaked.

Meat cuts and meat trimmings are frequently packed directly in shipping containers in the meat cutting department. Space for holding a day's supply of these containers is provided so that they will not become soiled before being used. Only clean containers are used, and strong, water resistant paper is employed to protect the meat from rough wood surfaces such as the inside of slack barrels or from the lint of burlap covers.

FIG. 48.—Truck of metal construction used for transporting edible fats from the slaughtering and cutting departments to the rendering department.

Edible Rendering Department.—The clean, edible fats derived in connection with the dressing of the carcasses in the slaughtering department and from the cutting of the chilled carcasses into their various parts are brought to this department to be converted into edible rendered fats such as lard and oleo stock. The edible fats are transported to the rendering department either by trucks or chutes. The trucks are of metal construction and of the kind that can be readily maintained in a clean condition. The chutes are also of metal construction and consist of sections that are demountable and easily handled for daily cleaning.

The rendering equipment is of sufficient capacity to readily accommodate the volume of edible fat produced in the plant and this refers particularly

to the fats derived from the carcass dressing operation which retain their body heat and will decompose quickly if not rendered promptly. It is important that the production of edible fat from the cutting department move promptly into the rendering tanks since it otherwise tends to cause congestion in the refrigerated compartments and it cannot be permitted to stand around in unrefrigerated areas where it will lose its chill and deterioration set in.

The equipment used for handling the edible fats and the location as well as the design of the charging opening of the rendering tank are such as to facilitate the transfer of the edible fat into the tank without danger of spillage and resultant contamination of the fat by contacting the floor.

The charging opening or head of the tank is usually located one floor level higher than the body of the rendering tank to facilitate the loading operation. The head of the tank extends up through an opening in the floor with several inches of clearance between it and the sides of the opening. The floor surrounding the opening is provided with a flange extending at least 8 inches above the floor level. This construction avoids any floor liquids from the higher floor level passing down through the opening to the lower floor level. It also permits vibration of the tank which frequently occurs during the rendering operation and facilitates the cleanup where the tank passes through the floor. Experience with heads of tanks set solid in the floor has been unsatisfactory since the vibration of the tank tends to open up the seal between the side of the tank and the floor resulting in the seepage of liquids down around the tank creating an insanitary condition with the leaking of floor liquids from the high level to the floor below and an unclean condition where the head of the tank passes through the floor.

Rendering Equipment.—*Open Kettle.*—This consists of a large steam jacketed kettle open at the top. The raw fats are hashed before being placed in the kettle and as the fat is rendered from the tissue by the heat from the steam jacket, the moisture passes off to the air. Generally, there is some agitation of the fat while it is being rendered. The rendering is complete when the moisture has been completely cooked away and the rendered fat separated from the dry tissue fibers. This method of rendering is employed in preparing kettle rendered lard.

Another type of open kettle is used in rendering oleo stock from edible beef and mutton fats. These kettles are provided with a hot water jacket instead of a steam jacket. The fresh fats are hashed before being placed in the kettle and are agitated during the rendering process. The object is merely to separate the rendered fat from the animal tissues by heating without any attempt to drive off the moisture. The moisture and tissues are settled out by scattering salt over the surface of the rendered mass and the supernatant rendered fat is drawn off.

The agitators used in this type of rendering equipment usually consist of paddles that revolve about a vertical shaft. This shaft is motivated by overhead gears. The overhead gears and shafts require attention to keep them free of particles that might drop into and contaminate the edible product being rendered in the tank, and drip pans are provided to catch any oil that might otherwise drop into the tank. These drip pans are

given regular attention to see that they are properly located and in place, and that they are kept free of extensive accumulations of oil and other débris.

Where vats of cold water are used to chill and float the fresh fats to the hasher and open kettles, the water is changed at frequent and regular intervals to assure that it is always clean and fresh and the tanks are of such construction that they can be readily cleaned. Attention is given particularly to cleaning the refrigeration coils that are submerged in the water. Not all of the fat placed in the tank floats to the hasher and open kettle. Some of it sinks to the bottom and when the tank is empty attention is given to these "sinkers" to detect and condemn any that have become unfit.

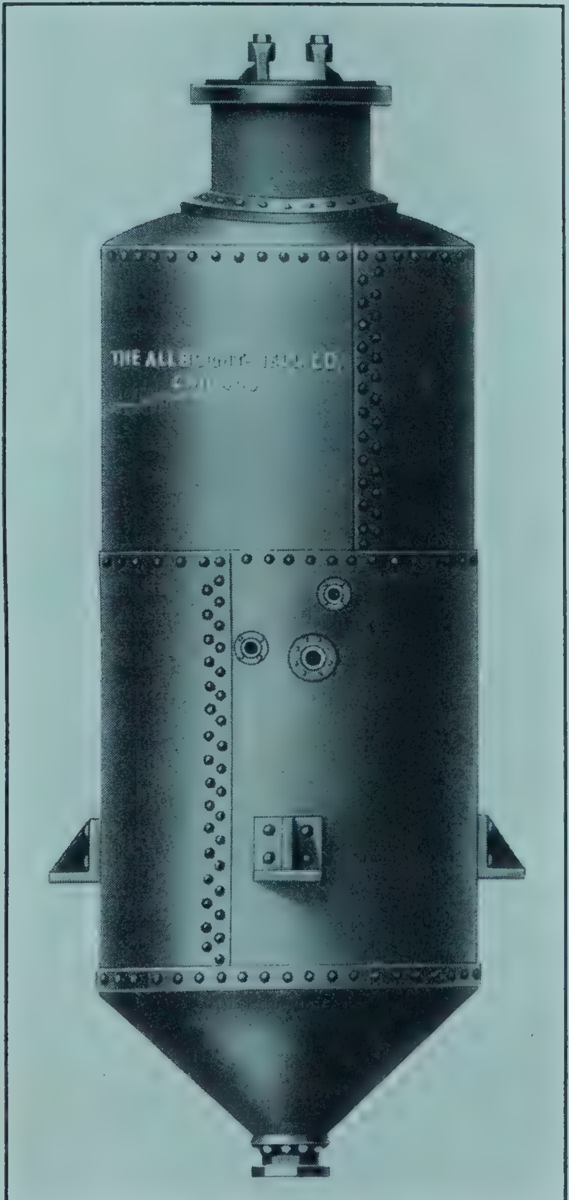


FIG. 49.—So-called "steam rendering tanks" used for rendering fats by injection of steam directly into the contents.

Steam Rendering Tanks. These are vertical cylinders constructed of heavy steel. They are like boilers in that they must withstand the high steam pressure that is built up in them during the rendering process and they are subject to considerable corrosion. The depth of the tank is usually a little more than twice the diameter. Steam is injected directly into the product in the tank until a pressure of at least 40 pounds is developed in the tank. The cooking of the material by direct contact with the steam distinguishes this method of rendering from all others. Before being used for rendering the tanks are thoroughly cleaned by washing them out. This is done generally with the use of a caustic solution. The tank is then filled about a third full of water and the fresh fats to be rendered are loaded in it up to within about 2 feet of the top.

If the operation of rendering has been carried on successfully, the contents of the tank will have separated into three layers of product: the tissue fiber and other débris in the bottom, tank water in the middle, and lard on top. When the loading has been properly done the line of demarkation between the lard and the tank water is approximately where the draw-off cocks are located. If for any reason this line of demarkation is above or below the draw-off cocks, the right levels can be attained either by the addition of water to the rendering tank or by the removal of tank water from it.

After the lard has been drawn off down to the level of the upper cock, water is gradually taken from the rendering tank and the line of demarkation between the lard and tank water is brought slightly below the lower draw-off cock. If this operation is carried out carefully, nearly all of the lard can be removed from the rendering tank without contamination from the tank water.

The contents of the rendering tank remaining after removal of the lard are dropped into a tank placed immediately beneath. This material consists of a mixture of fiber and tank water with a small amount of rendered fat and partially cooked material. The mixture is heated to the boiling point and allowed to stand until the clear fat and partially cooked material have risen to the top of the tank. These are carefully skimmed and the rendered fat is separated from the partially cooked material.

During the rendering operation steam is vented from the top of the tank for the purpose of avoiding the development of an air pocket in the tank. This steam is not permitted to discharge into the rendering department but is vented into a pipe which directs it to the sewer.

Dry Rendering.—This is accomplished in a large, horizontal, steam jacketed tank equipped with agitators revolving on a horizontal shaft extending the length of the tank. Vapor lines connect these tanks with condensers which make it possible to conduct the rendering operation under a partial vacuum. This accomplishes two things, the principal one being to render the fat at comparatively low temperatures ranging from 180° to 200°F. and the other the rapid removal of moisture from the product. The rendering is completed when the moisture is completely expelled from the product and the rendered fat has been separated from the tissues.

The tank is thoroughly cleaned and attention is given particularly to the agitators to see that they are clean on all sides. The condensers are

carefully maintained in operating condition for the efficient removal of the moisture from the tank, the maintenance of a vacuum in the tank, and the control of odors which are condensed along with the vapors and carried off to the sewer.

Equipment for Handling Rendered Fat.—The rendered fat as it leaves the tank requires settling to remove moisture and tissue particles which are drained off with it from the rendering tank. These settling tanks are equipped with heating coils to maintain the rendered fat in liquid condition so that the settling may be facilitated. The tanks receive regular attention to maintain them in a clean condition and cleanup is particularly thorough where the heating coils are located.

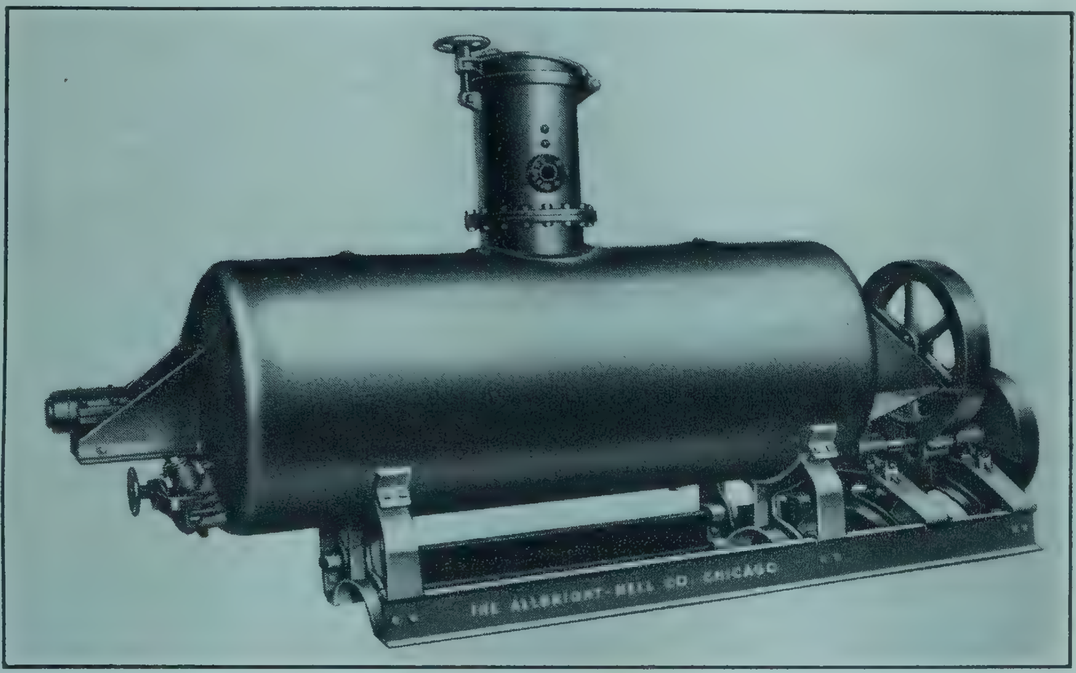


Fig. 50.—So-called "dry rendering tank" in which the heat used for rendering the fats is applied by a steam jacket.

Storage tanks are also necessary to provide a reservoir between the rendering operation and the shipping of the rendered fats from the establishment. These tanks are also provided with heating coils, however, the fat is not maintained in a heated condition but it is necessary to melt the fat when it is pumped from the storage tank. The cleanup of the storage tank is quite similar to that of the settling tank.

The pipelines, pumps, and valves used to convey the rendered fat are demountable and maintained in a clean condition. The distribution system used for handling rendered fats in the establishment is under constant examination to detect any point along the line where the product might stagnate and spoil. An accumulation of spoiled rendered fat anywhere in the system can contaminate a large quantity of product.

Rendered fat tends to develop a grainy condition if allowed to set up without agitation. Equipment is provided, therefore, to avoid this when rendered fat is put up in cartons, buckets, and other containers for shipment

to the trade. A chill roll is the device commonly used for this purpose. This consists of a large refrigerated cylinder that revolves slowly. The liquid rendered fat is picked up by the cold surface of the cylinder on one side of the piece of equipment and the chilled, solidified fat is scraped off the cylinder into a hopper on the other side of the roll. There is an agitator in this hopper and the solidified fat is picked up at one end of it and conveyed to the filling machine. Care is exercised in the location of a chill roll to make certain that it is protected against dust and moisture. A large surface of edible rendered fat is exposed on the chill roll and it would readily pick up any particles or moisture from the surrounding air.

Refining.—The refining of edible rendered animal fats consists principally of treatment with alkalies, mixing the fats with filter aids, and filtering out the filter aids. The equipment consists of tanks and filters. The tanks are large and open top. They may be equipped with coils for heating the rendered fat and with agitators for stirring it. The cleanup of these tanks and their auxiliary equipment is accomplished the same as with other fat handling tanks in the rendering department. The filter presses used to filter the rendered fat sometimes consist of a series of plates and use many layers of cotton duck material called filter cloths. It is necessary to dismantle these filter presses regularly to clean the plates and replace the filter cloths.

The Residue Resulting from Rendering.—The tissue remaining after drawing off the rendered fat in the various rendering processes contains a substantial amount of fat. In the case of the residue from wet rendering, there is also present a large amount of moisture.

The residue from the wet rendering, after being heated and allowed to settle for the purpose of drawing off the rendered fat that rises to the top, is conveyed directly to the inedible rendering department where it is retorted along with inedible materials to reclaim as inedible rendered fat any of its fat content.

The residue resulting from the dry rendering processes contains a considerable amount of rendered fat. This is extracted by pressing either in a hydraulic press, a screw press, or an expeller. The hydraulic and screw press are of rather simple construction and are readily cleaned, however, it is necessary to dismantle the expeller as part of its cleanup.

Curing Department.—The air in curing departments tends to become saturated with moisture and as a result the walls, ceilings, and floors are at times quite damp. Regular and thorough cleanup in this department is necessary to control the growth of mold and prevent the production of a slimy condition on the surfaces of the wall and ceiling. These surfaces are, therefore, of impervious material as well as the floors which are pitched to drains so located as to facilitate cleanup and prevent accumulation of floor liquids.

Curing is conducted under refrigeration usually at about 38°F. This is necessary to prevent spoilage of the meat while it is undergoing the process of curing. In any case, the action of the curing materials on the meat only gives it a relative stability, and it is necessary not only to cure meat under refrigeration but also to hold the cured meat in a refrigerated condition during its storage incident to distribution to the trade.

Frozen fresh meats are frequently brought to the curing department, and it is necessary to defrost such meats before being subjected to the curing process. Space and equipment specifically provided for the defrosting of meats are necessary in order to avoid congestion of the curing department and assure that the defrosting will be done under sanitary conditions. Furthermore, the defrosting of the frozen meats is done under careful control to assure that certain of the meats will not completely lose their chill and enter into the first stages of decomposition. The defrosting of meats in warm rooms is dangerous in this connection since part of the meat will tend to lose its chill while the remainder is still frozen.

The defrosting of meat is accomplished either by spreading it on racks or by placing it in tepid water. During the defrosting of meat, juices tend to separate from it. The meat, therefore, is so arranged on racks that the juices will not drip from one piece of meat to the other and the racks are located over a drained area so that the juices will pass directly into the sewer and cleanup of the area will be facilitated. When the defrosting of the meats is conducted in warm water, the water is usually agitated to facilitate the defrosting. This water takes up the meat juices as the meat thaws out and it is necessary, therefore, to change the water at regular intervals so as to maintain clean conditions during the defrosting operation.

Curing Materials.—Salt is inspected for cleanliness when it arrives at the establishment. It is examined for indication that it had been handled under clean conditions prior to its arrival at the meat packing plant. The presence of lint, vegetable matter, soil, and the like justify its rejection for use as a curing material for meat. Care is exercised to see that the salt is handled under clean conditions after it is received at the establishment. If the salt is dumped directly into the vat where it is to be dissolved in water for pickle manufacture, the opening into the vat is so constructed as to guard against the entrance of any contaminant through this opening. In some cases the salt is stored in bins from which it is taken to be used for several purposes in the plant. Such bins are so constructed that the salt can be dumped from the bin through a hopper directly into the hand trucks or other equipment for transporting the salt about the establishment. It is difficult to avoid the contamination of the salt when a storage bin is so arranged as to require a workman to enter it for the purpose of shoveling out the salt.

The nitrates, nitrites, and sugar are handled in containers that protect the contents from soilage and they are stored under clean conditions in the plant. The nitrates and nitrites are potentially harmful materials and care is exercised to assure against the accidental inclusion of excessive amounts of these materials in meat products. It is usually necessary for them to be kept under lock and made the responsibility of a particular plant employee.

Pickle Manufacture.—This consists of putting the salt in solution and clarifying the solution by settling and filtering. The vat in which the water is injected into the salt serves also as the first settling vat. That being the case, it is necessary to clean it out at regular intervals. The filtering device is one that is readily demountable and the filtering materials are such as to permit ready and thorough cleaning. In this connection filtering

cloths are preferred to sponges as the latter do not lend themselves to thorough cleaning.

The settling and filtering of the salt solution incident to the preparation of pickle have for their purpose the removal of insoluble materials that may be present in the salt. This method of handling, however, does not justify the use of unclean salt in pickle manufacture.

Pickle that had been used for curing meats is sometimes reclaimed and used again. The curing pickle left after meats have been removed from the cure still retains a considerable proportion of the curing ingredients which can be used again. This reclamation requires very careful handling if the pickle is to be used with safety in subsequent curing.

The usual system is to boil the used pickle, settle it overnight, skim the surface, remove the settlings, then filter and immediately chill it to a temperature of 26° to 28°F. At the same time it is raised to 100° Salometer by the addition of salt. The equipment used for reclaiming pickle is thoroughly cleaned between each batch.

Pumping Equipment.—Large cuts of meats, such as hams, shoulders, and beef briskets, are injected with pickle into their interior. This is done by forcing pickle into them through a large hollow needle which is inserted deep into the meat and particularly to points along the bones of hams and shoulders. It is important that this pickle be free from contaminant because otherwise each injection of pickle into the meat would amount to an innoculation of the meat with dangerous organisms. Accordingly, the container holding the pumping pickle, the line from this container to the pump, the pump whether manual or mechanical, the line leading away from the pump, and the needle are maintained in scrupulously clean condition.

Curing Equipment.—This refers to the tierces, hogsheads, vats, and boxes in which the meat is placed with the pickle. It is preferred that these containers be movable and of a size that can be readily handled. This permits them to be taken from the curing department to the equipment cleaning area to be cleaned following the completion of the cure of each batch of meat. Attempts to clean equipment in the curing department create unsatisfactory conditions there.

Curing equipment is never connected directly with the sewer. This avoids their interior becoming contaminated should there by any backing up in the sewer lines due to stoppage. Also there should be no continuity between the interior of meat handling equipment and the drainage lines.

Curing equipment is made of wood, galvanized metal, and stainless steel. Stainless steel curing equipment is most easily cleaned and maintained in a sanitary condition. Wooden equipment can be maintained in a clean condition so long as it is in good repair.

Galvanized metal is very extensively used, principally for curing bacon in what are called "bacon boxes." Galvanized metal tends to corrode and form a surface of white crusts in the presence of pickle. This can be controlled through a method of cleaning and surface protection that maintains these bacon boxes in a satisfactory sanitary condition. The galvanized metal box is dipped in a series of two vats, the first containing a hot solution of an alkali detergent such as sodium carbonate, sodium metasilicate and

sodium hydroxide at 150°F. and the second a solution of an acid cleaner such as sodium bisulfate or monosodium sulfate at 130°F. The box is rinsed thoroughly before being placed in the first solution so as to keep the solution as clean as possible. The box is permitted to soak for twenty minutes in the first solution after which it is removed and placed in the second solution. It remains in the second solution from twenty to thirty minutes, depending on the degree of corrosion on the box.

When the corrosion becomes softened, the box is hoisted from the solution and immediately brushed with a metal sponge. The corrosion is easily removed if the box is brushed while it is warm and wet. After the corrosion is completely removed the box is thoroughly rinsed and it is heated by plac-

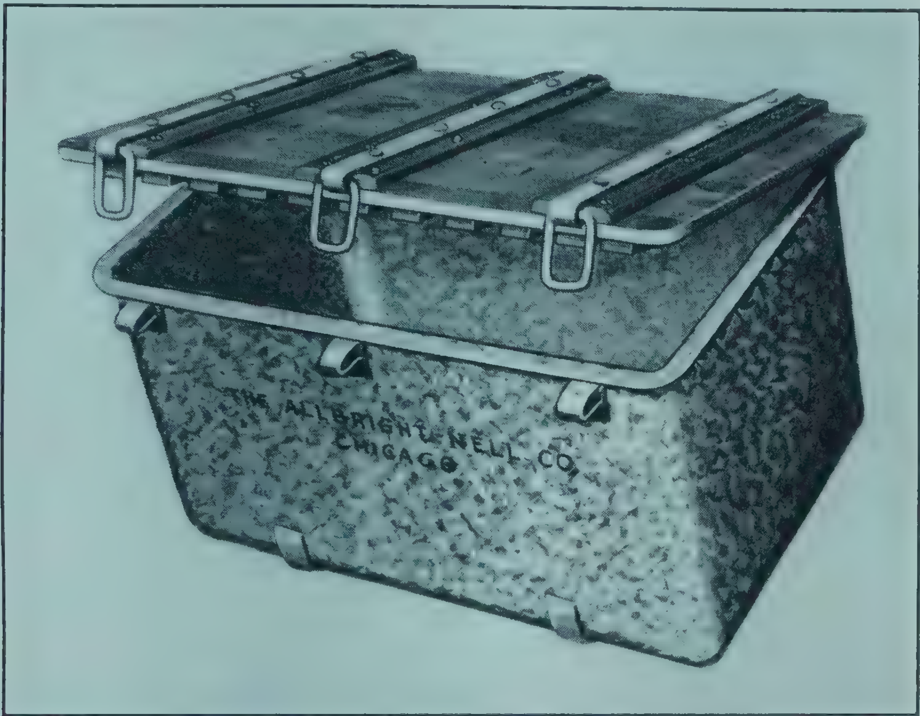


Fig. 51.—So-called "bacon box," made of heavy seamless galvanized metal.

ing it over a steam jet. The purpose of heating the box after rinsing is to facilitate its drying before the protective coating of paraffin wax is applied. As soon as it is dry and while still warm the box is coated on all surfaces with a hot paraffin wax preparation. The coating consists of a mixture of 1 part paraffin wax and 1 part paraffin oil. This coating should be applied so as to constitute a very thin covering for the surface of the metal. A thick application tends to break and flake off and the particles may contaminate the product.

Dry Salt Meats.—Not all meats are cured by immersing them in pickle. Some are cured by rubbing them on all sides with a mixture of salt with other curing ingredients. These meats are then stacked between layers of the curing mixture. Such meats are stacked on racks well above the floor so that the bottom of the stack will not be contaminated by floor liquids

Cured Meat Storage.—After the meats have been cured it sometimes becomes necessary to accumulate stocks of cured meat incident to its distribution to the trade. They are stored at temperatures ranging from 26° to 38°F. depending on the length of time they are to be held which usually does not exceed thirty days at such temperatures. The cured meats are stored in bins that are demountable and hold the meat at least 1 foot above the floor. Following the removal of the meat the bin is dismantled and taken from the refrigerated department to the equipment cleaning area where the sections are thoroughly cleaned and aired before being returned to the refrigerated department.

Smokehouses.—The smokehouse and the approach to the smokehouse are constructed so that they can be readily cleaned. The approach to the smokehouse, or as it is sometimes called, the "smokehouse alley," where the cured meats are hung before being placed in the smokehouse is drained to take care of the drip from the cured meats. This area is also vented so that the smoke as it escapes from the smokehouse when the doors are opened will pass to the outside rather than enter the meat processing departments adjacent to the smokehouse area. The walls and overhead construction of this area are of impervious material which will permit their being washed down as part of the cleaning operation.

The interior of the smokehouse is smooth and impervious. This is necessary to permit the walls being washed down with caustic solution to remove accumulations resulting from the smoking operation. The floor of the smokehouse is impervious and drained so that the wash water may pass directly into the sewer. When a smokehouse is more than one floor level high and it is entered from each floor level, care is exercised to see that the meat hanging in the lower level is not contaminated as a result of traffic in and out of the smokehouse at the higher level.

Sometimes steam is injected into the smokehouse to mingle with the smoke during the smoking process. When this is done the amount of steam is so adjusted that it will not result in condensation on overhead structures with resulting drip and contamination of the meats being smoked.

Sausage Department.—Owing to the large variety of meat food products prepared in what is usually called the sausage department and the various processes to which a large volume of meat is subjected in this department, careful attention is given to the layout of the department and flow of operations in it. The maintenance of standards of cleanliness is possible only if adequate equipment and space is provided for each processing operation.

The walls, floors, and ceilings are of impervious material that will permit thorough cleanup following each day's operation, and floor drains are provided. The equipment is of rust resisting metal construction so designed as to permit ready and thorough cleaning. Tools such as shovels, paddles, knives, and the like are of metal construction and have no crevices in which meat juices or meat particles accumulate and decompose. Containers, such as pans, tubs, and pails that are used for conveying meats, cereals, condiments, and the like, are placed off the floor on racks or trolleys. This method of handling so-called "tipping" containers avoids the con-

tamination of the meat products with floor liquids that might otherwise be picked up by them and drain off into the food.

Chopper.—The plates and knives of chopping equipment are demountable to facilitate thorough cleanup following each day's operation. The knives are so constructed that there are no crevices in the plate in which they are set where meat particles and meat juices might gather and decompose. The knives in some classes of chopping equipment rotate at high speed. Precautions are taken to see that these knives are in good repair so that

FIG. 52.—Sausage stuffer showing cover swung away to one side.

particles of metal from broken knives will not contaminate the food. Also, these knives rotating at high speed sometimes splinter when they hit hard particles such as a piece of bone. At such time the equipment is immediately stopped and the meat contaminated with metal splinters is eliminated.

Stuffer.—The sausage stuffer consists of a cylinder with a removable top, and in the cylinder is a snug fitting piston which forces the meat through the stuffing horn. The top is removable and the horn and its valve are demountable. These are dismantled and cleaned thoroughly after each day's operation. There is a cleanout opening at the bottom of the cylinder. This opening which is covered by a tight fitting plate permits in-

spection of the back side of the piston to detect any meat or meat juices that might have passed around between the piston and the wall of the cylinder. The cylinder is cleaned out regularly to eliminate any accumulation of meat particles or meat juices behind the piston head. To assure that the stuffer is maintained in a clean condition at all times, it is necessary occasionally to remove the piston from the cylinder as part of the cleanup.

A large metal table accompanies each sausage stuffer extending away from the stuffing horn. This table is used as a work surface for linking and tying off the stuffed sausage. Liquids accumulate in varying amounts on this table and it is therefore drained in such a way as to direct these liquids to the sewer by way of an interrupted connection. This drain is of such construction as to permit its being thoroughly cleaned as part of the daily cleanup.

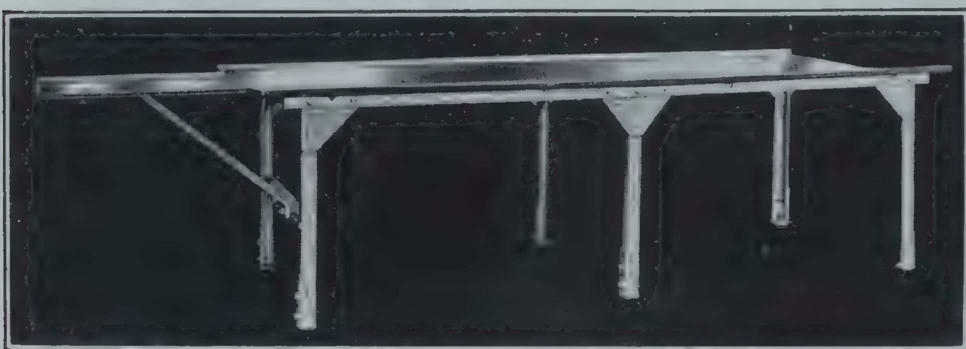


FIG. 53.—Sausage stuffing table.

Spice Room.—Spices and condiments are kept in a room adjacent to the sausage department. The room is reserved for this use and every precaution is taken to keep these materials in clean condition. The spices and condiments are stored in closed metal containers placed on racks at least 12 inches above the floor. The containers used for weighing and mixing the spices and condiments are also metal and of the kind that can be readily kept in a clean condition.

The spice room is not used as a general storage room since the handling of other materials in such a room creates an unsatisfactory surrounding in which to store and handle spices and condiments.

Dry Storage.—Supplies of many kinds are accumulated in the meat packing plant for use in connection with its meat production and packaging as well as for plant maintenance. Good housekeeping and cleanliness in storerooms are essential to a successful rodent control program. Since the supplies, for the most part, consist of materials used as ingredients of the meat foods prepared in the establishment or are packaging materials for such foods, the supplies are stored and handled under clean conditions so that they will not constitute a possible source of contamination for the meat foods.

So-called "dead" storage is avoided in the food processing plant because it is difficult to accomplish a progressive program of cleanup in an area

where there is such storage. Storerooms are provided for supplies that are currently needed as part of the daily operation. These supplies are placed on racks at least 12 inches from the floor and passageways are maintained between rows of racks. A systematic turnover of supplies is accomplished so as to avoid the accumulation of old and useless material. Also, as the supplies are removed from the storeroom the racks are taken up and cleaned and the immediate floor area is thoroughly cleaned before the racks are put back into place and used again for supplies.

Hide Cellar.—There is complete separation of the hide cellar from all other departments in the meat packing plant. The only connection between it and the slaughtering department is the chute used for conveying the hides to the hide cellar. This chute is closed and vented at the slaughtering floor end. It is provided with a trap door which permits the hides to enter the chute and then closes automatically. The vent exhausts to the open air any odors which might pass up the chute from the hide cellar.

The walls, floor, and ceiling of the hide cellar are smooth and impervious so that cleanup may be facilitated. The floor is pitched away from the areas where the hides are stacked for curing, and floor drains are provided in the aisles between the stacks so that the liquids that develop during the curing of the hides may pass directly to the sewer.

Facilities are provided so that the cured hides may be removed from the establishment without passing through departments or over loading docks where edible products are handled. The hide cellar is located, therefore, so that the cured hides may be moved directly from it to the exterior of the building where they may be loaded on trucks or cars using loading facilities specially provided for the purpose. This loading area is paved and drained and provided with a cleanup hose outlet.

Inedible Department.—This department performs a very important function in a meat packing plant particularly when slaughtering is conducted. It disposes of the large volume of inedible materials of animal origin that are produced incident to slaughtering animals for human food. The disposal of this large volume of material much of which is very objectionable in character is accomplished on the premises without creating a nuisance only when the inedible department is properly equipped and maintained.

This department is completely separated from all other departments of the meat packing plant except those few openings into the edible products department that are necessary to convey the inedible materials from the other parts of the plant. The shipping dock serving the inedible products department is entirely separate from shipping facilities used for other purposes in the plant.

The walls, ceilings, and floors are made of impervious material throughout this department and are of smooth finish to permit thorough cleaning. The floors are pitched to drains so located as to control floor liquids and facilitate cleanup. Cleanup hoses are conveniently located throughout the department.

Wherever possible chutes are used to convey the inedible materials through their various steps of handling to the inedible rendering tanks and in those cases where chutes cannot be used, the material is conveyed

by hand trucks of metal construction that can be readily cleaned following each day's operation.

The principal handling that the inedible materials receive in the inedible products department preparatory to tanking has for its purpose the removal from it of the contents from the digestive tract and to hash it to facilitate rendering. The inedible material is passed through hashers that reduce it to a shredded mass which is discharged into large revolving perforated cylinders where a spray of water washes out most of the contents of the

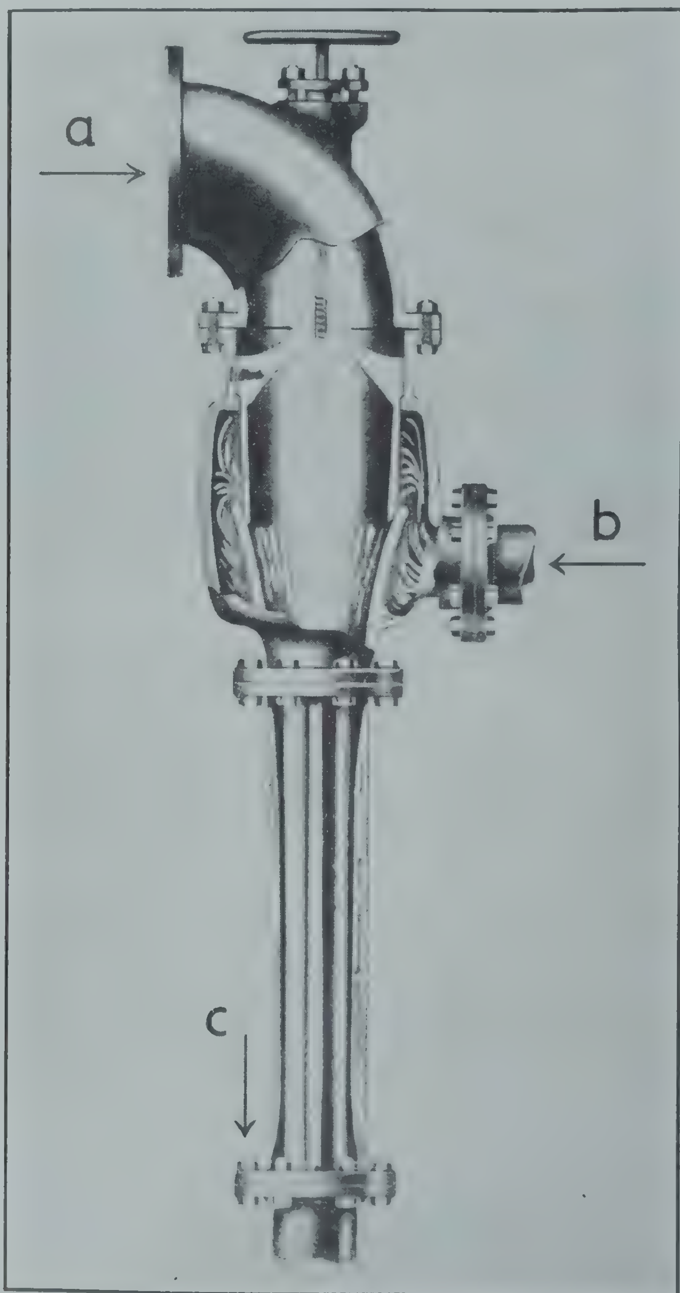


FIG. 54.—Odor condenser: *a*, Hot odor laden vapors enter condenser; *b*, cold water line; *c*, water and condensed vapors pass to sewer.

digestive tract. The hasher and washer are enclosed in a curbed and drained area connected directly with the sewer.

Odor Control.—Objectionable odors are produced in the inedible department in connection with the handling of the inedible material preparatory to rendering, and they are discharged along with the vapors from the rendering tanks. Closed vapor lines from the rendering tanks are connected with condensers. In these condensers the hot vapors from the rendering tanks are showered with cold water. This cold water condenses the vapor and at the same time dissolves many of the offensive gases and carries them to the sewer. The offensive gases in the vapor lines that are not dissolved in the condenser water are vented to a chamber where they are in some cases chemically treated while in others directed to the boiler stack where they are either burned or discharged to the atmosphere high in the air. The rooms throughout the inedible products department are also vented to the chamber that receives the undissolved offensive gases from the vapor lines. The room odors are controlled in the same way either by chemical treatment or they are discharged into the boiler stack.

Inedible rendered fat and tankage are produced in large quantities in the inedible rendering department. Accordingly, adequate facilities are provided for their storage and shipment from the plant. The pipe lines used to convey the inedible rendered fats are marked distinctively to avoid their being confused with pipe lines used to convey edible rendered fat.

Chapter

8

FACILITIES FOR INSPECTION

The observance at a meat packing plant of the principles of meat hygiene is dependent to a large extent on the effectiveness of the inspection supervision given such a plant. The personality and training of each inspector are factors that are influenced by the training program of the particular meat inspection organization. However, the inspector who is capable and properly trained, functions effectively only if he is provided with adequate facilities for the conduct of his inspection.

The inspector is provided with dressing room and office facilities in the meat packing plant apart from similar facilities used by plant employees. This arrangement permits the inspection organization to maintain its identity as a functioning entity in the plant.

Each operation in the plant that is concerned with the processing and handling of the meat as human food is planned and conducted so as to give the inspector an opportunity to inspect. For example, no slaughtering is conducted and no meat is prepared except during the hours when the inspector is present. When the meat packing plant is laid out and equipped, appropriate space and equipment are provided at those points where inspection is required. Furthermore, the management of the meat packing plant provides the inspector with such assistance as is necessary to facilitate his inspection.

The general cleanliness in the meat packing plant, or what is sometimes referred to as environmental sanitation, is controlled by the inspector through his ability to require clean conditions surrounding the handling and preparation of the meat for human food. He accomplishes this by prohibiting the preparation of meat in an unclean environment or under unclean conditions. This prohibition is enforced by the inspector through the exercise of his power to reject an unclean department or unclean equipment. This rejection is enforced by using a reject notice which is posted in the department or affixed to a piece of unclean equipment. The reject notice carries a warning that the department or equipment so identified shall not be used until it has been placed in a clean condition and released for use again by the inspector.

The inspection supervision extends to all steps in the production of meat and its products in the meat packing plant from the time the animal is presented for slaughter to the shipment of the meat food product to the trade. Facilities for performing the inspection are provided for each step.

Ante-Mortem Inspection.—The animals intended to be slaughtered at the meat packing plant are placed in pens sufficiently large to permit the

inspector who conducts the ante-mortem inspection to move among the animals for the purpose of observing them to detect any abnormal condition. The pens are well lighted so that the inspector is able to detect deviations from normal in the animals that he observes. He is given an assistant who is furnished by the plant for the purpose of moving the animals about

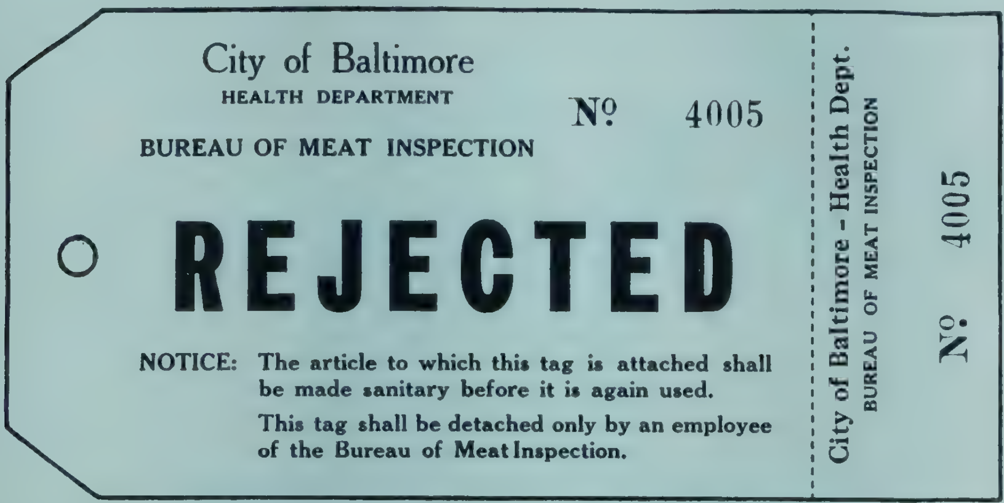


Fig. 55.—Tag used by inspectors of the Health Department of the City of Baltimore to prohibit the use of any unclean article in connection with food.

a

b

Fig. 56.—*a*, Metal tag used by Federal meat inspectors to identify animals that are "suspected" on ante-mortem examination; *b*, metal tag used by meat inspectors of the City of Baltimore to identify animals that are condemned on ante-mortem examination.

as the inspector might require and to separate out the animals that are suspected of being affected with an abnormal condition.

The inspector is furnished with ear tags for use in identifying the animals which he does not pass for slaughter. These animals are separated from the other animals and removed to a holding pen where they can be given a more

thorough physical examination. This holding pen is provided with facilities for restraining the animal should it be necessary for the examination. If the animal is found to be affected by a condition that requires its condemnation, it is identified with an ear tag reading "Condemned" and facilities are provided for removing it directly to the inedible rendering department

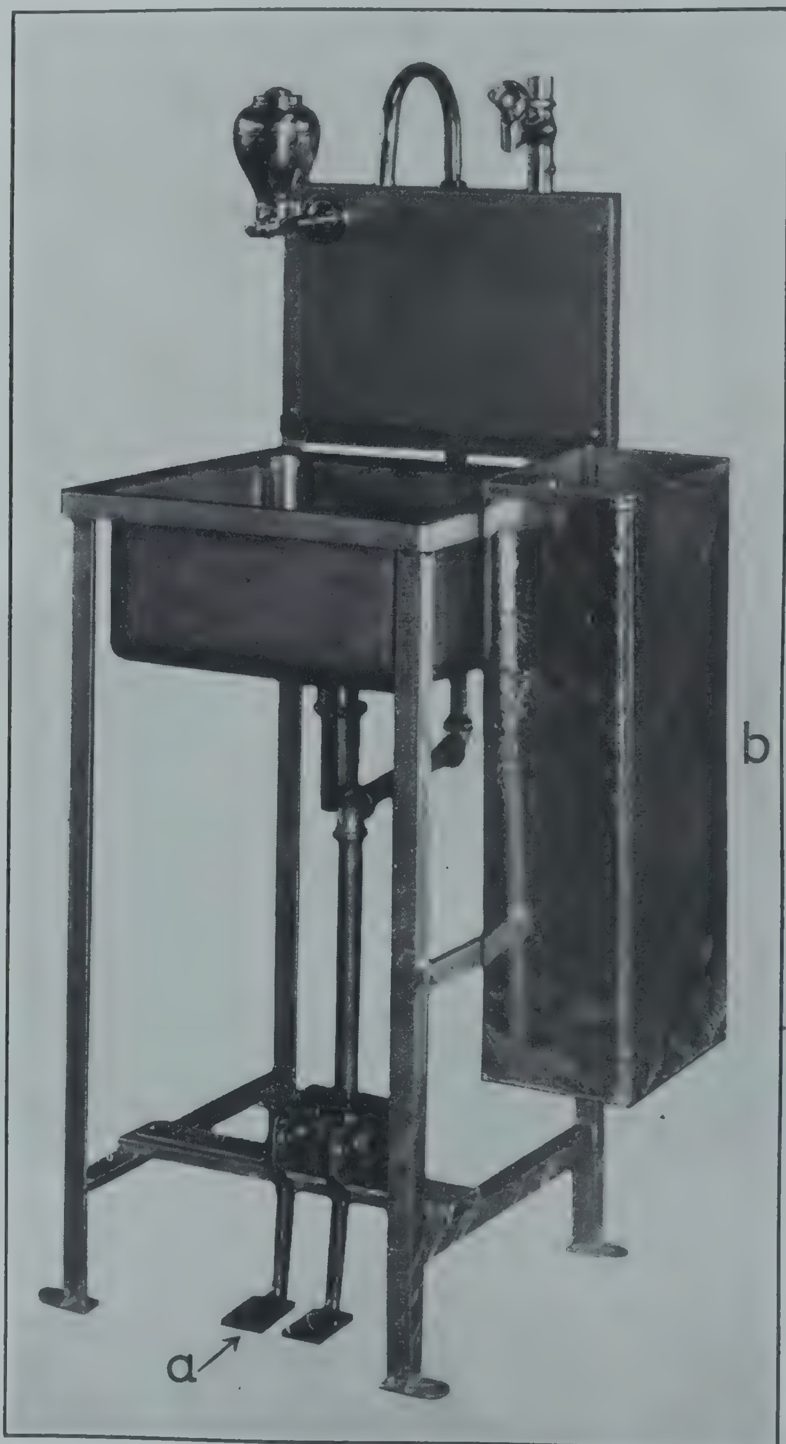


FIG. 57.—Lavatory and sterilizer: *a*, Foot valves; *b*, sterilizer.

for disposal without entering an edible products department. The animal suspected of being affected with a condition which might influence the disposition of its carcass on post-mortem examination is marked with an ear tag reading "Suspect" and facilities are provided for removing animals so identified to the slaughtering department separate from the animals that are passed without restriction.

Post-Mortem Inspection.—The steps in the slaughtering operation differ somewhat for each species. However, with the exception of inspections conducted on the carcasses of sheep and goats which do not include the examination of the cervical lymph glands, there are three routine post-mortem inspection locations and one location for the inspection of retained carcasses in each slaughtering layout. The routine inspection locations are first, the place where the head and cervical glands are inspected, second, the viscera inspection position, and, third, the place where the eviscerated carcass is examined before it leaves the slaughtering department.

At each inspection location there are one or more units consisting of a lavatory and a sterilizer. The water outlet delivering tempered water is located 12 inches above the rim of the bowl of the lavatory and a liquid soap dispenser is provided. The water is either allowed to flow constantly into the lavatory or there is a foot pedal operated valve. The sterilizer which contains boiling water is used to disinfect disease contaminated equipment, such as the knives used by inspectors. The water is kept boiling in the sterilizer by injecting live steam into it.

Section tags bearing identification numbers are affixed to heads and corresponding carcasses when the head is separated from the carcass, such as occurs during the dressing of beef carcasses. This permits assembling for final inspection both parts of the same carcass when a disease condition is found in either one.

The inspector uses tags and brands to maintain the identity of diseased and condemned carcasses and parts. When a diseased or otherwise abnormal condition is found by the inspector, he affixes a "Retained" tag to the various parts of the carcass and its viscera. The retained tag comes in gangs of three for use on small stock and five for use on cattle. In addition to the word "Retained" they are printed with a serial number which is identical on each gang of tags. When a condition is found which requires condemnation of a carcass or any part thereof, the word "Condemned" is branded in prominent letters on the carcass. The brand is applied repeatedly to carcasses and large sets of viscera so that the word "Condemned" is prominently displayed. The words "Retained" on the tags and "Condemned" on the brand are accompanied with an identification of the agency having jurisdiction, as for example, "U. S. Retained" and "U. S. Condemned."

The inspectional and sanitary control by an inspector in a slaughtering department is completed by his power to limit the speed of slaughter to his ability to inspect. Since the rate of the slaughtering operations in departments that have a substantial volume is determined by the speed of the chain on which the carcasses travel, the inspector is furnished with a push button or other device for limiting the speed of this chain. This enables the inspector to meet situations which sometimes arise in connection with an

unusually high incidence of diseased carcasses or an insanitary condition. For example, it is sometimes necessary to stop the chain to enforce the requirement for clean hog carcasses.

The equipment used for the inspection of cattle and calf heads and their cervical glands is similar. Where there is a small volume of slaughter, the heads, after they have been removed from the carcass and cleaned thoroughly, are placed individually on loops which present the ventral and posterior surfaces of the head for the inspection. These loops are removable so that they can be taken from the rack or truck for cleaning as each head is removed. The inspection of the head is completed while it is on the loop

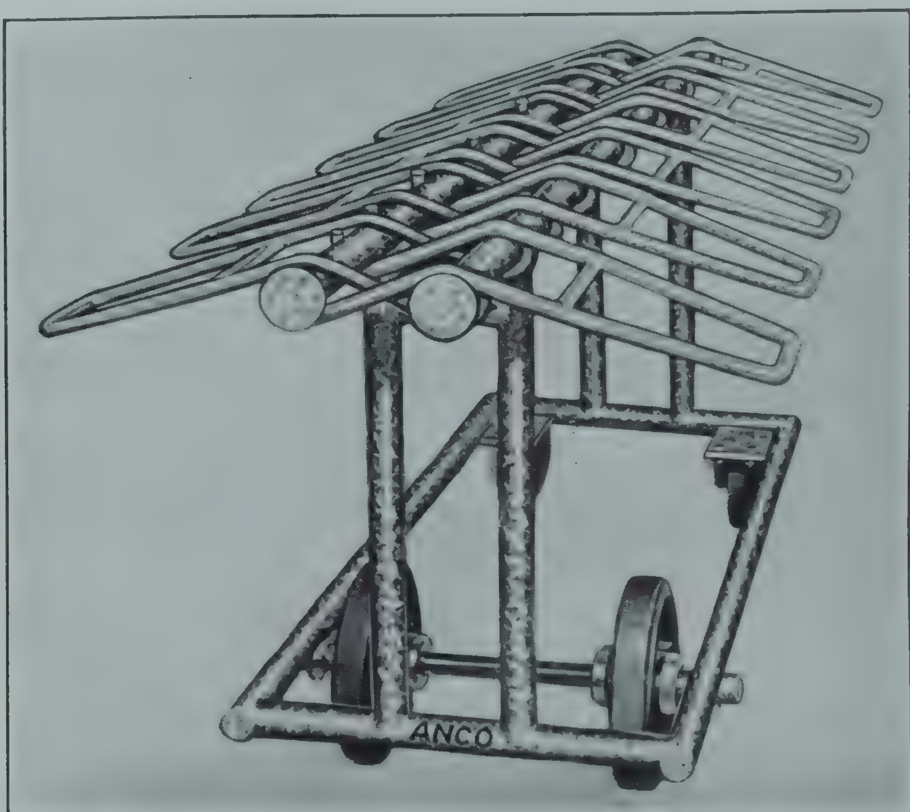


FIG. 58.—Loops on which cattle heads are placed for inspection.

and it is not removed from the loop until after the carcass from which the head was taken has passed the inspection. This necessitates furnishing a sufficient number of the loops to accommodate heads from all of the carcasses that are in the process of handling in the slaughtering department beginning from the time the head is removed until the time that the carcass passes the rail inspection.

In slaughtering departments that have a large production capacity, there is furnished a moving chain provided with hooks on which the heads are placed for the inspection. The hooks on such a chain are spaced 24 inches apart so that the heads as they are suspended from the hooks will not contact each other. The point of the hook is 54 inches above the standing level of the inspector. The chain passes through a cabinet which cleans

and disinfects the hooks to avoid the probability of carrying contamination from a diseased head to one that is passed for food. The length of the chain is determined by the number of hooks that are necessary to accommodate the heads from all of the carcasses in the process of dressing.

Depending on the rate of slaughter, the heads of hogs are either inspected while still attached to the carcass or they are removed from the carcass and presented for inspection along with the viscera. The heads are inspected while attached to the carcasses when slaughtering operations of considerable volume are involved.

Fig. 59.—Cattle heads being inspected while suspended on hooks from a moving chain.

In those cases where the hog head is inspected while attached to the carcass it is severed from the cervical vertebræ at the poll and it is dropped by cutting transversely permitting it to hang attached to the carcass by leaving a portion of the ventral surface of the neck intact. This presents the postpharyngeal region for inspection. It is important that the position of the head and its height above the level where the inspector stands is such that it is convenient and readily accessible for the inspector. When the hog head is presented with the hog viscera for inspection, both the head and the viscera of the same animal are presented together for inspection. The head is placed in a pan equipped with a loop for steadying

Fig. 60.—Hog heads being inspected while attached to the carcass.

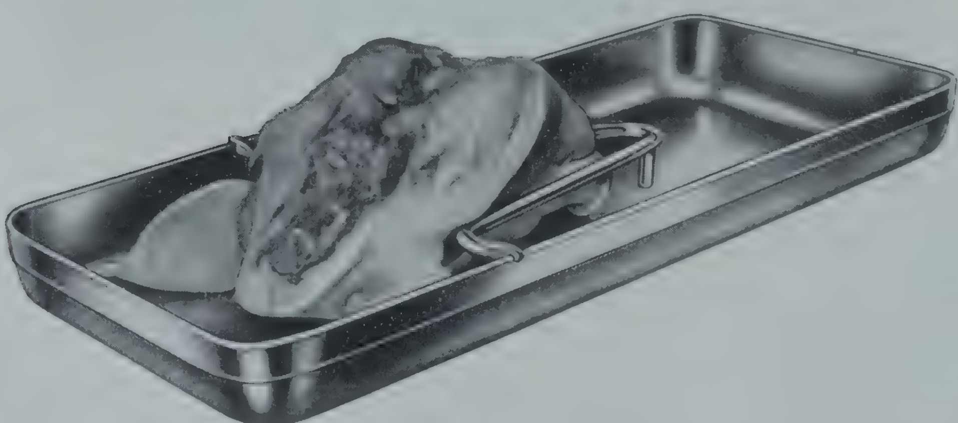


Fig. 61.—Pan showing hog head in position for inspection.

it in position for inspection. This pan is 1 foot wide and 30 inches long. It is made of rust-resistant metal and is readily removable from the stand on which it is placed. The pan is cleaned before receiving each head, and should it become contaminated, facilities are provided for submerging it after cleaning in boiling water. This arrangement for placing the head in a pan for inspection at the same time inspection is conducted of the viscera is also used in connection with small scale calf slaughtering operations.

Viscera Inspection.—The viscera of cattle are presented for inspection either in a hand truck specially designed for the purpose or on a moving table. The viscera truck is used in cattle slaughtering departments having a low rate of slaughter. This truck has a large low-slung body approximately 1 foot deep to accommodate the stomachs and intestines, and there is a pan approximately 26×26×3 inches in which the lungs, heart, spleen, and liver are presented for inspection. This pan is to the rear of and elevated above the main body at a height of 30 inches from the floor.

Fig. 62.—Hand truck for holding cattle viscera for inspection.

The area in the vicinity of the carcass where evisceration is conducted is sufficiently spacious to accommodate the viscera inspection truck and permit free movement of the inspector to enable him to perform his inspection duties. Off to one side of the slaughtering beds there is located an area at least 7×8 feet that is drained and enclosed on three sides. The viscera inspection trucks are brought to this area for cleaning and disinfecting following the handling of each set of viscera. In this area are hose outlets of tempered water for cleaning and water of 180°F. for disinfecting.

When a moving table is used for presenting cattle viscera for inspection the carcass passes over the table and the viscera is dropped directly on the table. As the viscera moves with the table to the inspection position, the eviscerated carcasses swerve away from the table so that the inspectors can be located on both sides of it to perform the inspection.

It is arranged that all of the viscera that is passed for inspection is removed manually from the table before it reaches the end of the table.

Only condemned materials are permitted to drop off the end of the table. They usually drop into a chute which conveys them directly to the inedible products department. The height of the table above the level where the inspector stands has an important bearing on the convenience with which he can conduct the inspections. The distance that has been found to be best for this purpose is 34 inches from the standing level of the inspector to the surface of the table.

It is necessary to reserve a specified area for the exclusive use of the viscera inspectors along the viscera inspection table. It is sometimes necessary to mark off this area with barriers so that it will not be encroached upon by other activities incident to the dressing operation.

FIG. 63.—Inspection being conducted of hog viscera on a "moving top" table.

A moving table consisting of a series of pans 24 × 30 × 3 inches is used for the inspection of viscera in hog slaughtering departments having a substantial volume. Another kind of moving table is used for the inspection of hog viscera in slaughtering departments of medium volume consisting of a series of two pans, one 24 × 30 inches for the viscera, the other 12 × 30 inches for the head.

In both cases the height of the table above the standing position of the inspector in 34 inches. Here again a specified space is reserved along the table for use exclusively by the inspector.

Stationary viscera inspection equipment is used in hog slaughtering departments of small volume. This consists of two pans on a metal frame, the pans being placed over a drained hopper connected with the sewer. One of these pans 24 × 30 inches accommodates the viscera, while the other

which is 12 × 30 inches is used for presenting the hog head for inspection. The same equipment is frequently used for inspecting the viscera of calves and sheep. Then the thoracic viscera and the liver and spleen are placed in the small pan and the stomachs and intestines are placed in the large pan. The same two-pan arrangement is used on a moving table for calves and sheep slaughtered in substantial volume.

Inspection of the Carcass.—The inspection of the carcass after evisceration is commonly called the rail inspection. Each carcass is examined by the inspector as it hangs from the rail. For the inspection of a beef carcass, the standing position of the inspector is 9 feet 6 inches from the top of the rail. For the rail inspection of a hog carcass, the standing position of the inspector is 8 feet 6 inches from the top of the rail. The distance from the gambrel to the standing position of the inspector for the rail inspection of sheep and calf carcasses is 7 feet 6 inches. Cattle carcasses are hung from the dressing rail on 8 foot centers. Three foot centers are provided on the dressing rail for calves and sheep. Three foot centers are also provided on the dressing rail for hogs when the two-pan arrangement is used on the moving viscera inspection table to present the heads as well as the viscera for inspection. When the hog head is inspected as it hangs from its carcass, 2 foot centers are adequate for the hog carcasses on the dressing rail.

Final Inspection.—This refers to the inspection given to carcasses and their viscera which are found on routine post-mortem inspection to have been infected with some diseased or other abnormal condition that requires them to be given a more thorough examination to determine whether they are suitable for human food. This inspection is conducted in a space specifically set apart for the purpose. Its size is determined by the volume and kind of slaughtering operation. It is located conveniently to the flow of carcasses in the dressing operation so that the carcass and its viscera, which are retained during routine post-mortem inspection on account of some diseased or abnormal condition, may be removed from the flow of the dressing operation for final inspection conveniently and without any danger of contamination of other carcasses or viscera.

The space in which the final inspection is conducted is equipped with head loops and viscera pans for holding these parts for inspection in connection with the final examination of the carcass. This area is drained and enclosed in such a way that cleanup and disinfection of the floor and contaminated equipment can be accomplished without endangering products in surrounding areas. In connection with slaughtering departments of large production with the handling of a large quantity of condemned carcasses and parts of carcasses in the space where the final inspection is conducted, chutes are provided for conveying the condemned material directly from this space to the inedible products department.

Inspection of the Manufacture of Meat Products.—Diseased and otherwise unfit meat and meat by-products are eliminated from the public food supply in the slaughtering department. Clean, fresh meats and meat by-products come to the manufacturing departments in the meat packing plant and the inspection activities in these departments are concerned with seeing that nothing in the handling of the meat or in what is added to the meat during the process of manufacture makes it unclean or otherwise

unfit for food. The facilities required for an inspection control that will accomplish this contemplates the handling of the meat in a clean environment with clean equipment, that no unfit or harmful ingredients are added to the meat, that it has been properly prepared, and that it is not mislabeled.

The inspector has an opportunity to examine into the cleanliness of the department and the equipment before meat is brought in for handling and processing. He has an opportunity to examine the containers in which the meat is placed to determine whether they are clean and whether they are so constructed that they will not contaminate the food. He examines materials that are intended to be used as ingredients of the meat food, eliminating those which are harmful, unclean, or otherwise unfit. He is provided with facilities to reject for use any department, equipment, or ingredient that is unsuitable.

The inspector is informed concerning the methods used in processing the meat foods, and such devices as dial thermometers which register the temperatures attained during the processing are provided so that the inspector can check the adequacy of the processing. The facilities provided for the inspector, so that he might properly supervise the methods used in the processing of the meat foods, have for their purpose such determinations as trichinæ control and safety of canned product. Also, the inspection supervision ascertains whether a product has actually been prepared in accordance with representations made in connection with its sale, as, for example, a product labeled with the word "roasted" is required to have actually been roasted.

The inspection control which has for its purpose the production of canned meats that are safe for distribution to the trade is concerned with the adequacy of the heat processing of the canned article. This is accomplished in two ways. Each batch of canned product as it comes from the closing machine is identified with a tag which changes color as it passes through the retort. The inspector can tell at a glance by the color of the tag affixed to each batch of canned product whether, in fact, a particular batch had been processed in the retort. The second test consists of incubating representative samples from each batch after the heat processing in the retort. A room held at approximately 100°F. is equipped with shelves for holding the samples of canned product and a recording thermometer that maintains a record of the room temperature. Each can of product is identified by code as to its contents and the date of processing. In this way the sample given the incubation test is identified with a particular batch of product which can be retained for reinspection should the sample not pass the incubation test.

Labeling.—Inspectional control over the composition of a product and the method used in its preparation as they relate to consumer expectancy is best exercised through the ability of the inspector to accept or reject the label intended to be used on a particular product. Since the opportunity to review a label after the product is prepared and ready for labeling would afford a minimum of opportunity for taking corrective action, prior inspectional review of labels is made. The management of the meat packing plant presents the label to the inspector for his review with information concerning the product on which it is to be used. If the inspector rejects the label,

the plant management is informed concerning the appropriate corrective action necessary to obtain acceptance for the label and correction is accomplished before the label is used on the product.

Control of Condemned Product.—The elimination of diseased or otherwise unfit meat and meat products by the inspector is effective only if such product, when condemned by him, is in fact destroyed for food purposes. The facilities for handling the condemned product incident to its destruction are therefore of utmost importance. The equipment used for handling and transporting condemned product is used exclusively for that purpose and is of watertight construction to avoid contamination of the premises or other products with diseased material.

FIG. 64.—Sample cans of lots of canned meats being examined after incubation.

The condemned product is kept constantly under inspection supervision from the time it is detected by the inspector until it is destroyed for human food. This is accomplished by a combination of personal supervision by the inspector and constructive supervision through the use of sealed containers, trucks, chutes, and compartments. These are constructed so that the seal cannot be tampered with or removed without detection by the inspector, and are of tight construction such as would make impossible the diversion of the condemned product.

Chapter

9

MATERIALS ADDED TO MEATS

Foods prepared from meat and with the use of meat ingredients are many and varied. In their preparation is used a large variety of materials that influence the flavor and character of the finished product. These materials, like the meat with which they are used, are proper ingredients of the meat food product only if they are clean, free from adulteration, and harmless. Some understanding on the part of the inspector of the origin and character of these materials gives him a proper background for making determinations concerning their acceptability for use at the meat packing plant. This chapter, therefore, considers briefly some of the materials most commonly used in meat packing plants in the preparation of meat food products.

Salt.—Common salt exists in nature either in a solid state or in solution. It is universally distributed over the earth and is the most abundant of the native soluble salts. In the solid state, it is called rock salt, halite, fossil salt, or sal gemmæ and is often found forming extensive beds and even entire mountains from which it is taken in blocks or masses by mining operations. The geological position of rock salt is very constant, occurring almost invariably in secondary formations associated with clay and gypsum.

The principal salt mines are found in Poland, Hungary, and Russia; in various parts of Germany and Austria, particularly the Tyrol; in Cheshire, England; in Spain; in various parts of Asia and Africa; in Turk's Island near St. Domingo; and in Peru and other countries of South America. There are a few mines in the United States located in Louisiana, Kansas, and in the western part of the State of New York.

Salt in solution exists in certain springs and lakes and in the water of the ocean. There are numerous salt springs in the United States which either flow naturally or are produced artificially by sinking wells to various depths in places where salt is known to exist. These are found principally in Missouri, Kentucky, Illinois, Ohio, Michigan, Pennsylvania, Virginia, West Virginia, and New York. Much commercial salt is obtained from the water of the Great Salt Lake in Utah which contains nearly 25 per cent of salt.

The salt is obtained from these various sources by crystallization from solutions which have been concentrated by evaporation using either solar or other source of heat for the purpose. Equipment used for crystallization varies from the retaining enclosures used for the concentration of water by solar evaporation to modern, triple-effect vacuum pans.

The size of the salt crystals is influenced by the evaporation temperature

and by the presence of foreign materials. Sodium chloride usually crystallizes in cubes but following quiet evaporation it often assumes the form of hollow quadrangular pyramids or hopper-shaped crystals consisting of an aggregation of cubes.

Pure sodium chloride is permanent in air but most of the commercial salt is more or less hygroscopic because of the presence of impurities. These include traces of insoluble matter and small amounts of calcium

FIG. 65.—Anise.

and magnesium sulfates and calcium and magnesium chlorides. This kind of salt which is used for culinary and for industrial purposes is generally damp from the hygroscopic character of the calcium and magnesium chlorides present. To overcome this tendency to become damp there is added to some kinds of table salt a small amount of moisture absorbent materials. For this purpose calcium phosphate, magnesium carbonate, and starch have been used.

Sodium iodide is added to some brands of table salt as a prophylactic measure to prevent goiter. The amount added is 1 part sodium iodide in

10,000 parts of salt. Salt to which sodium iodide has been added is not permitted to be used as an ingredient of meat products. Indiscriminate use of so-called "iodized" salt may have an injurious effect on health.

Seasonings.—Spices. These are exclusively of vegetable origin and owe their flavoring quality to the presence of aromatic essential oils in their cell structure. Unlike fatty oils, the essential oils volatilize at ordinary temperature. Only those spices are fit ingredients of food that are clean,

FIG. 66.—Basil.

free from débris and adulteration, and have not deteriorated in aromatic strength. Being of vegetable origin they may accumulate vegetable and soil débris in connection with their gathering and handling. Since they are rather expensive and are sold according to weight, there is a temptation to increase their bulk by adding less expensive material. The essential oils, being volatile, tend to evaporate and the spices deteriorate in aromatic strength as their age increases. Spices also deteriorate through oxidation and resinification of their essential oils.

Allspice.—Allspice, also called pimento and jamaica pepper, is the dried unripe fruit of the pimento tree which belongs to the myrtle family. The fruit which appears soon after the blossoms is a smooth, glossy, succulent, globular berry from $\frac{2}{10}$ to $\frac{3}{10}$ of an inch in diameter, about the size of a small pea. The berry is not allowed to ripen fully because it then becomes black and tasteless, losing its aromatic property. During the harvesting care must be exercised to separate the inferior, ripe berries from the unripe ones. The allspice tree is found on most of the islands in the Carribean Sea and it is most abundant in Jamaica which produces the greater part of the commercial allspice.

Anise.—It is the seed of an annual herb of the carrot family that came originally from the Orient. It has an intensive sweet taste.

Basil.—This is an annual herb of the mint family called herb royale in France. It is reported as being a native of India and Africa but it is now cultivated widely as an aromatic plant for seasoning. The characteristic aromatic flavor is contained in the leaves of the basil plant.

Paprika.—This is one of the less pungent of the varieties of red pepper. The substance that gives red peppers their pungent properties is produced almost entirely in the thin paper-like tissues of the placentæ to which the seed is attached. Even in the mild paprika pepper this sometimes is somewhat pungent. The degree of pungency of ground paprika may, therefore, depend on the thoroughness with which the placentæ are removed. The removal of the seed and placentæ results in a mild product while grinding the whole fruit makes a product of more pungency. The so-called Spanish paprika is the mild type.

Pepper.—Both black and white pepper are products of the black pepper vine native to the forests of western and southern India and for centuries cultivated on the Malay Peninsula, Sumatra, Java, Ceylon, Siam, and Borneo. They are the only spices that grow on a climbing vine. Black pepper is the unripe, dried berry of the pepper vine. White pepper is produced from the ripe berry by removing the outer coat. This is accomplished by soaking the berry in water for several days and rubbing off the outer coat by friction. White pepper is also made from the dried black pepper berry by milling it to remove the outer coating. Since the greater strength of the pepper berry is found in the outer cover, the white pepper tends to be milder in flavor than the black pepper.

Sage.—This is a member of the mint family and is a shrub-like perennial cultivated in many countries of moderate climate. The leaves and the small tops of the sage plant contain the characteristic aromatic quality.

Thyme.—This is a small perennial shrub also of the mint family. Thyme is harvested when the plant is in bloom. The bloom and green parts of

the plant are used and in the preparation of this spice the stems are eliminated. The lemon-scented is the best variety of thyme.

Mustard.—Commercial mustard seed is obtained from several closely related species and varieties of brassica which are annual plants of wide geographical distribution. The seeds of these varieties differ slightly in size and range in color from pale yellow to black. The most important varieties are the yellow (sometimes referred to as white mustard), the brown, and the oriental types. There are three sources of commercial seed that is consumed in the United States, (1) seed produced in the United States under cultivation, (2) seed from wild plants obtained from grain screenings, and (3) imports. The yellow seed unground is frequently used in pickle, especially in sweet mixed pickles. Mustard leaves are sometimes used for garnishing. Mustard oil has a very sharp taste and acts upon the skin as a strong irritant.

Nutmeg and Mace.—These are produced by the same tree which is an evergreen. The fruit of the nutmeg tree is about 3 inches long and about 2 inches in diameter and occurs on the tree intermingled with flowers. The fruit hangs pendulous from the tree and is fleshy and firm, being pear-shaped when ripe. The outer covering of the fruit is at first thin and gradually grows fleshy. As this becomes dry it bursts open into two valves from the apex disclosing a brilliant scarlet aril or net-like membrane revealing the nutmeg kernel. The kernel is closely invested in a thin brown shell which separates it from the aril or mass that envelops both. The nutmeg fruit includes, first, the outer or fleshy membraneous part; second, the substance covering the inner shell of the nutmeg which is the mace; third, the inner shell, and, finally, the kernel or nutmeg.

The flavor of mace and nutmeg is somewhat similar but nevertheless distinct. The flavor of mace is preferred by some people and it generally costs more than nutmeg.

Turmeric.—Turmeric is a large-leafed herb closely related to ginger and of the same family. Its rhizome, or underground stem, like ginger, contains the characteristic aromatic flavor. This spice has a bright yellow color and a pleasant, musty flavor. It tends to impart its color to the food in which it is used.

Sweet Bay.—This spice consists of the leaves of a small tree of the laurel family that is a native of the Mediterranean region. The tree is commonly used as an evergreen tub plant and is of the same family as cinnamon and sassafras. It is also cultivated in shrubberies and sheltered gardens in Europe. There is no relation between sweet bay and bay rum. Bayberry leaves impart to bay rum its characteristic flavor.

Capers.—They are the flower buds of the caper bush which is found in southern Europe and along the Mediterranean. The smallest, greenest buds have the finest flavor and they are gathered fresh in the morning before they have opened. Capers are pickled in white vinegar and salt. Buds of bean-caper and nasturtium are sometimes substituted for capers.

Caraway.—This spice consists of the seed of a biennial or annual herb of the carrot family. It is supposed to have originated in Caria in Asia-Minor from where it gets its name. Caraway seeds have a hot and acrid but pleasant taste. They are exported from Holland, Prussia, Morocco,

and Russia. Caraway is usually sown with coriander. The coriander is harvested before the caraway produces a flowering stem. Young shoots of the caraway plant are used for flavoring soups and stews.

Cardamon.—This is the fruit of various East Indian or Chinese plants of the ginger family. All are natives of the tropical parts of India.

Cassia.—Cassia bark and cassia buds are derived from one or more species of trees of the laurel family. The buds are the dry, unripe fruit of the Chinese cassia tree. The bark and buds have a cinnamon flavor. The bark is considered to be less desirable than cinnamon and is used chiefly as a substitute for it.

Cayenne.—This and other pungent red peppers are obtained as dried fruits from an annual herbaceous plant widely cultivated in many parts of the world and variable in the character of its fruit. They are closely related to the so-called sweet or mild-flavored variety commonly grown in home gardens. The pungent varieties are used as dried peppers to distinguish them from the others used in fresh condition and classed as vegetables. Included among the dried peppers is the paprika, a mild type (see page 195).

The pungent red peppers as they appear in the trade vary in size, shape, and degree of color and pungency. The pungency is greatest in the tissues near the seed and the extent to which these tissues are used determines to some degree the pungency of the finished product. The varieties of pungent peppers are known under various names such as chili, cayenne, and tabasco.

Celery seed.—The celery plant is a biennial herb sometimes an annual and is widely grown in all temperate regions. The dried fruit commonly called seed is very aromatic and is extensively used for flavoring foods.

Chives.—These are bulbous, onion-like plants of the lily family. They are grown throughout Europe, Asia, and America. Chives have an odor and taste resembling onions and the leaves are frequently used instead of onions for flavoring.

Cinnamon.—The bark of the cinnamon tree which is an evergreen of the laurel family is the usual cinnamon distributed to the trade. The entire tree has an aromatic quality; however, the bark contains the typical flavor of cinnamon. The true cinnamon is a native of the Island of Ceylon where it appears to make its best growth. However, it also is grown in southern India, Burma, and the Malay Peninsula. The quality of the bark depends on its position on the branch. That from the middle is the best. The top is second best, and the third grade comes from the base or thicker part of the branch. The best bark comes from shoots two years old, particularly those grown in the shade.

Cinnamon bark has a pleasant odor and a slightly sweet taste. In addition to being used as a spice, it is also used in the maufacture of incense.

Cloves.—These are the dried, unopened flower buds of an evergreen tree belonging to the myrtle family, native of tropical and subtropical regions throughout the world. They get their name from the French "clou" meaning nail which they resemble somewhat. Cloves were one of the principal Oriental spices, being the basis of a rich trade since early times. The clove is very rich in essential oil containing a greater proportion than

any other plant. Water extracts very little of the flavor of cloves. The essential oil combined with resinous material gives cloves their pungency and their aromatic property depends on the amount of oil they contain. The best cloves are large, plump, purplish-brown in color and unbroken.

Coriander.—The article known as coriander seed consists of the dried, ripe fruit of a hardy annual herb of the carrot family. The ripening of the coriander fruit is progressive and this causes some difficulty in the harvesting of the crop which may start when approximately one-half of the total fruit formed has turned gray. The plant is indigenous to southern Europe, Asia Minor, and the southern part of Russia, and has been planted in most parts of the world where the climate is suitable. There has been no sustained commercial production in the United States.

The unripe fruit has a distinctly unpleasant odor characteristic of other parts of the plant. The ripe, dry fruit, however, has a pleasant aromatic taste.

Cumin.—This is the aromatic fruit of a small, slender, herbaceous annual of the caraway type cultivated in India and the Mediterranean region of Europe. It is known in the trade as cumin seed. It has not been produced commercially in the United States. The seeds have a peculiar strong aromatic odor and hot taste.

Dill.—This is the aromatic fruit (called seed) of a hardy annual or biennial herb of the carrot family. It is grown as a commercial crop in the North Central States of the United States, however, it is a native of southern Europe. Probably its most extensive use in foods is in the pickle industry. The best quality seed is that which has fully matured but has not turned brown in the field.

Garlic.—This is a bulbous, onion-like member of the lily family and is a native of southern Europe. Garlic belongs to the same genus as chives, leek, onions, shallot, and the Welsh onion. The bulbs and leaves are both used as seasoning. The whole plant has a peculiar taste and smell which is taken up by the breath and perspiration of the consumer. The strong flavor is due to an oil that is rich in sulphur.

Ginger.—This is a biennial or perennial herb native to the tropics and cultivated in tropical countries in both hemispheres. The aromatic portion of the ginger plant is the rhizome or underground stem often referred to as the root. This rhizome has a characteristic pungent taste. For dried ginger the treatment of the rhizomes depends on whether it is to be sold as unpeeled or peeled ginger. The unpeeled product occurs in the trade as either "green" or "black" ginger. The "green" is obtained by drying the rhizomes after removing the soil and roots. To produce "black" ginger, the cleaned rhizomes are scalded in boiling water and then rapidly dried. For the production of peeled ginger, a thin layer of the skin of the rhizomes is removed with special care to prevent loss of the oil cells which are close to the surface. Ginger is one of the most popular flavoring agents.

Marjoram.—Sweet marjoram is a widely cultivated perennial plant native to the Mediterranean region. It is a member of the mint family. The leaves, flowers, and tender stems present a peculiarly aromatic and fragrant odor and are a very popular seasoning. They are cut as soon as the plant begins to flower.

Spice Extractives.—Volatile or essential oils and fixed oils or oleoresins containing the aromatic principles are extracted from spices and are a popular and convenient flavoring for meat foods. As they are available to the meat packing industry they possess uniform flavoring strength and therefore are more easily blended with ingredients of the meat food products with uniform results. Most essential oils consist of mixtures of hydrocarbons (terpenes, sesquiterpenes, etc.), oxygenated compounds (alcohols, esters, ethers, aldehydes, ketones, lactones, phenols, phenol ethers, etc.), and a small amount of viscid or solid non-volatile residues (paraffins, waxes, etc.). Of these the oxygenated compounds are the principal aromatic substances although the terpenes and sesquiterpenes also contribute in some degree to the total flavor value of the oil. The oxygenated substances with the exception of some aldehydes are relatively stable against oxydizing and resinifying influences and are soluble in dilute alcohol. The terpenes or sesquiterpenes due to their unsaturated character oxydize and resinify easily which destroys their flavor value. Oils in which they are present are also less soluble in alcohol.

Essential oils are generally liquid and volatile, or, upon heating, evaporate without decomposition. Their flavoring value depends on these characteristics.

Various methods of extracting essential oils are used depending on the character of the raw material. There are three methods of distillation and in the case of oils of mustard and bitter almond the crushed seeds are fermented prior to distillation. The kinds of distillation are (1) water distillation, (2) water and steam distillation, and (3) direct steam distillation. In all cases the material to be extracted is thoroughly comminuted before being placed in the still.

Water Distillation.—When this method is employed the material to be distilled comes in direct contact with boiling water. Some plant materials must be distilled while fully immersed and moving freely in boiling water because on distillation with injected live steam (direct steam distillation) these materials aggultinate and form large compact lumps through which the steam cannot penetrate.

Water and Steam Distillation.—In this method the plant material is supported on a screen some distance above the bottom of the still. The lower part of the still is filled with water to a level somewhat below the screen. The wet steam at low pressure rises through and saturates the plant material. The features of this method are that the steam is always fully saturated, wet, and never superheated, and that the plant material is in contact with the steam only and not with boiling water.

Direct Steam Distillation.—Live steam saturated or superheated and frequently at pressures higher than atmospheric is introduced through open or perforated steam coils below the charge through which it penetrates.

Methods other than distillation include the extraction of essential oils by pressure with or without the use of heat and by solvent methods using neutral oils, alcohol, petroleum ether, and benzene as the solvent.

When the volatile oils are extracted from the source material by its immersion in neutral oils, such as olive oil or lard, the aromatic or essential oil is finally collected by extraction with ethyl alcohol. When petroleum

ether is used it is first freed from sulphur and nitrogenous compounds by washing it in turn with sulphuric acid, water, hot dilute sodium hydroxide solution, water, and then drying. Industrial benzene often contains pyridine, carbon dioxide, and thiophene which are first removed by treatment with concentrated sulphuric acid and caustic soda solutions.

The essential oils as they are supplied to the meat packing industry for use as flavoring materials in meat food products are concentrated flavoring oils, free of terpenes and sesquiterpenes. Such oils consist mainly of oxygenated compounds. They are more soluble, more stable, and are much stronger in aromatic quality, yet contain most of the odor and flavor characteristics of the original oil. Generally, the method used in preparing these refined oils is based on two principles; (a) removal of the terpenes and sesquiterpenes, and paraffins by fractional distillation under vacuum, or (b) by extraction of the more soluble oxygenated compounds with dilute alcohol or other solvents; in some cases a combination of the two methods is used. Essential oils commonly used in the meat packing industries are: oil of cardamon, oil of clove, oil of coriander, oil of cubeb, oil of cumin, oil of nutmeg, oil of parsley, oil of sage, oil of savory, and oil of thyme.

Sucrose.—Cane Sugar.—Sugar cane was originally indigenous to India. It has been cultivated for its saccharin juice since remotest antiquity. At the present time, it is cultivated in all tropical and subtropical countries. It was introduced into the West Indies by the Spaniards early in the Sixteenth century and these islands, especially Cuba, are now the world's largest producers. Sugar cane is cultivated by cuttings which are planted in rows and which, by giving rise to successive shoots, furnish five or six crops before the plants must be removed. At the end of a year or more the plant flowers but before this takes place the canes are richest in sugar and are cut down. The cane juice is said to contain 17 per cent of crystallizable sugar though not more than 13 per cent is extracted in practice.

When ripe, the cane is cut close to the ground, stripped of leaves and flower tufts, and transported to mills. Because of danger of inversion, the cane must reach the crusher within a few hours. At the mill the cane is cut into short pieces and these are passed through the crushers which press out the juice. The juice is strained, warmed to 93°F. and run into settling tanks for a short time.

After settling, the cane juice is still turbid, and is acid in reaction. It is treated in mixing tanks with enough lime to render it slightly alkaline, and heated until a crust of precipitated material forms. The clear juice is drawn off. It is evaporated in vacuum pans, first to a concentrated syrup and in a second operation, to crystallization. The mass of crystals still contains some water and about 82 per cent sucrose. The crystals are separated from the adhering water by centrifuging. The liquid so obtained is molasses. The crystals constitute the raw sugar shipped to refineries for further processing.

In refining, the raw sugar is mixed with mother liquor from a previous batch; this removes much of the color but does not dissolve the crystals. The crystals are separated by centrifuging after which they are washed and dissolved in a minimum of warm water to form syrup. This is treated with a little lime, heated with steam, and then filtered through a column of

charcoal. The filtered liquor is concentrated to a crystalline mass in a manner similar to the treatment of raw sugar. It is then centrifuged and dried in a rotary drier to produce granulated sugar. Purification to a nearly white product can be attained by repeated washing in the centrifuge. In some cases, it is bleached with sulphur dioxide which is added prior to the filtration through charcoal.

Molasses.—There are two kinds of molasses, the West India and the sugar-house. West India molasses is a black, thick liquid of a peculiar odor and sweet, empyreumatic taste. When mixed with water and with the skimmings of the vessels used in the manufacture of sugar, it forms a liquor which, when fermented and distilled, yields rum. Sugar-house molasses, also called golden drips and grocer's syrup, is thicker than the West India molasses and has a different flavor. As found in commerce it is sometimes adulterated with glucose. Both kinds of molasses contain uncrystallizable sugar, more or less cane sugar which has escaped separation in the processes of manufacture or refining, and they contain gummy and coloring matter.

Beet Sugar.—In obtaining sugar from the sugar beet, the root of the plant is freed of leaves, washed, and cut in slices. The term "noodles" is sometimes used to describe the slices. These are extracted with hot water and yield a dark solution containing about 12 per cent sucrose. This warm solution is treated with lime and the mixture is saturated with carbon dioxide. This causes a precipitate which is filtered out and the process is repeated until a clear liquid is obtained. This is pale yellow in color and may be made almost colorless by adding sulphur dioxide. The solution is then evaporated and the crystals washed and dried in a centrifuge. The mother syrup is concentrated and re-worked. A by-product of this operation is a molasses that contains uncrystallizable sugar and is a product similar to sugar-house molasses.

Invert Sugar.—The inversion of cane sugar by dilute acids is a characteristic phenomenon involving sucrose. It is called inversion because before the change takes place the sucrose is dextrorotatory, while after the hydrolytic reaction it is lævorotatory. The reaction is as follows:

$$\underset{\textit{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \rightarrow \underset{\textit{Dextrose}}{C_6H_{12}O_6} + \underset{\textit{Levulose}}{C_6H_{12}O_6}$$

The resulting solution is lævorotatory because levulose is more strongly lævorotatory than dextrose is dextrorotatory. The amount of acid that will produce the change is very small. One drop of hydrochloric acid will invert a solution containing 1 pound of sucrose in a few minutes at the optimum inversion temperature of 80°C. Commercial invert sugar which is used in food products and sometimes as an adulterant of honey is usually prepared by the use of citric acid as the inversion medium, 4 ozs. of citric acid being sufficient for 500 lbs. of sucrose. Invert sugar is sweeter than sucrose and is the cause of the cloying sweetness of some syrups and preserves in which inversion has been produced by the natural acidity of the constituents.

Honey.—The United States is said to be the greatest honey producing region in the world, the annual production being between 100,000,000 and

169,000,000 pounds. California is the largest honey producing State. Honey is a thick, syrupy liquid of a light yellowish to reddish-brown color. It is translucent when fresh but frequently becomes opaque and granular through crystallization of dextrose. It varies somewhat in its composition. The principal constituents are a mixture of dextrose and levulose in the same proportions as in artificial invert sugar and in an amount ranging from 65 to nearly 80 per cent. Sucrose is present in honey in from ½ to 8 per cent; dextrin from less than 1 to 10 per cent. Honey is usually lævorotatory.

From the nectaries of various flowers, the bee and other insects extract a thin, aqueous fluid nearly without flavor and insipidly sweet, usually known as nectar. The nectar when taken in by the bee is changed by secretions from glands in its head and thorax forming levulose, dextrose, and rarely, sucrose. The finest honey is that which is allowed to drain from the comb. Centrifugal extractors are employed to separate the honey from the comb after cleanly slicing off the ends of the cells with a sharp knife. Centrifuged honey is much cleaner than that produced by other methods. An inferior kind is procured by submitting the comb to pressure, and if heat is employed previous to expression, the product is still more impure.

Dextrose.—Corn Sugar.—In the manufacture of corn sugar, cornstarch is suspended in water to form a milk-like mixture which is poured into converters built to withstand a pressure of 50 pounds per square inch. The starch suspension is acidified with hydrochloric or sulphuric acid and is heated at about 40 to 45 pounds pressure until all the starch is converted to dextrose. The liquor obtained from the converter is transferred to neutralizers in which the pH of the mixture is raised to 4.8 to 5.2 with sodium carbonate. This is filtered and decolorized with activated carbon. It is then evaporated in multiple-effect evaporators, decolorized again with activated carbon, evaporated again in a single-effect unit and allowed to crystallize.

A number of types of dextrose products are prepared. However, the pressed dextrose sugar is obtained by squeezing the syrup coming from the vacuum pan in hydraulic presses. This separates most of the sugar from the dark-colored mother liquor called corn molasses or hydrol. The refined corn sugar is made by refining processes similar to those used in the cane sugar industry. The syrup from the vacuum pans is passed into warm cylindrical tanks in which it is stirred by spiral agitators so that solid lumps of crystals and dextrose hydrate cannot form. Crystallization takes place in from six to ten days. The mixtures of crystals and syrup is then centrifuged, pressed through a tandem of cylindrical drum driers and sifted. This produces a product consisting of nearly 100 per cent dextrose.

Cerelose.—The syrup from the vacuum pan in the process described above for manufacturing corn sugar is permitted to stand at about 90°F. after being grained with pure dextrose. After crystallization has taken place, the mother liquor is removed by centrifugal methods previously described. Cerelose contains about 9 per cent water, the remainder being practically all dextrose.

Protein Hydrolysates.—Interest in the flavor building properties of protein hydrolysates goes back to the discovery of the processes used in the Orient to convert soy beans to soya sauce. The slow conversion of the soy bean meal portion of the basic materials used for soya sauce preparation is, in part, due to the action of naturally occurring vegetable enzymes and the resulting splitting off of various amino acids, particularly glutamic acid. Soy bean meal contains approximately 20 per cent of glutamic acid. Oriental diets are greatly restricted as compared to those available to the peoples of other countries. The monotony of taste of the foodstuffs available to the majority of Orientals was probably responsible for the development of soya sauce.

Enzymatic hydrolysis of soy bean meal usually results in the formation of ammonia from acid amides. An Oriental soya sauce has been found to contain ammonium complexes of amino acids including ammonium glutamate. Ammonium glutamate undoubtedly plays a part in building up the flavors associated with soya sauce, and it is significant that from the time monosodium glutamate became commercially available it has been customary in the Orient to use it as a flavor reinforcement in soya sauce. The proteins that have been found to be best suited for the production of protein hydrolysates for use as food flavoring have been those that are high in total nitrogen, adequate in respect to all the amino acids, and high, particularly, in glutamic acid content. Commercially, these proteins are wheat gluten, corn gluten, extracted soy bean flour, casein, peanut flour, yeast, dried distiller's solubles, and extracted cottonseed meal. Sometimes a combination of proteins is used and it is possible to obtain a dry hydrolysate containing as high as from 16 to 18 per cent monosodium glutamate. So-called autolyzed yeast is a type of protein hydrolysate used as a food flavoring. This is prepared by hydrolyzing yeast protein through enzymatic action. Another type of protein hydrolysate used as a food flavoring is sometimes described as a complete acid hydrolyzed protein which contains a combination of all the amino acids with a high glutamic acid content. A third is the refined monosodium glutamate.

Monosodium Glutamate.—Glutamic acid is one of the most common of the amino acids and is a constituent of practically all proteins. Liberation of the acid from its natural sources invariably begins with a hydrolysis. This can be effected in three general ways: through the use of enzymes, heating in the presence of an acid, or heating in the presence of an aklali. The acid and alkali methods of hydrolysis are usually used in the production of glutamic acid. The processing steps are essentially (1) hydrolysis to free the glutamic acid from other substances, (2) separation of glutamic acid, (3) purification of the glutamic acid, (4) conversion to monosodium glutamate, and (5) crystallization, separation, and drying of the purified monosodium glutamate.

When monosodium glutamate was first produced in Japan it was claimed by some to possess a meaty flavor. The claim for a meaty flavor accompanied the article when it was introduced into the United States. This has given way to the belief that monosodium glutamate should be classed as a salt type of seasoning rather than as a condiment possessing a distinctive flavor.

Saltpeter.—This is the commercial name given to three natural occurring nitrates, (1) Chile saltpeter, cubic nitre, or sodium nitrate, (2) ordinary saltpeter, nitre, or potassium nitrate, (3) wall saltpeter or calcium nitrate. Only (1) and (2) are the saltpeters used in the meat packing industry as ingredients of meat products. The saltpeters occur in nature as efflorescences resulting from the oxidation of nitrogenous matter in the presence of alkalies and alkaline earths.

Saltpeters have been used as ingredients of curing mixtures for meats for so long a period that there is no record of when saltpeter was first added to salt in the treatment of meats. It appears probable that its usefulness in curing meats was recognized following the development of a substantial saltpeter industry in Europe in connection with the production of gunpowder beginning in the Twelfth and Thirteenth centuries.

Chile Saltpeter.—The only commercially available natural deposits of nitrate are those covering large areas in South America, especially in the provinces of Tarapaka and Antofagasta in Chile. The areas are confined to a narrow strip $2\frac{1}{2}$ miles wide and 260 miles long. The nitrates form beds varying in thickness from 6 inches to 12 feet under a conglomerate consisting of rock fragments, sodium chloride, and various sulphates cemented together by gypsum to form a hard, compact mass 6 feet to 12 feet thick. The deposit of nitrate generally has a granular structure and varies in color, being yellowish-white, bright lemon yellow, brownish, or violet. It contains from 48 to 75 per cent of sodium nitrate and from 20 to 40 per cent sodium chloride. These are associated with various minor saline components including sodium iodate, more or less insoluble minerals and also some organic matter. The organic matter consists of guano which suggests the idea that the nitrate was formed by nitrification of this kind of excrement material.

The deposit is worked up locally by extracting it with hot water. First, the suspended material is allowed to settle and then the clear liquid is drawn off to a cistern where it deposits part of its sodium chloride at high temperature. The remaining liquid is drawn off to another cistern where, on cooling, the sodium nitrate crystallizes out of solution. These crystals constitute the commercial product known as Chile saltpeter.

Ordinary Saltpeter.—The natural occurring potassium nitrate has no commercial value today. It occurs in the superficial layers of soil of many countries especially in certain parts of India, Persia, Arabia, and Spain. In early times these deposits furnished much of the saltpeter that was used in gunpowder manufacture. The demand for saltpeter in those days for use as an ingredient of gunpowder led to its production in France and Germany and other European countries where natural conditions were simulated by exposing to atmospheric action heaps of decaying organic matter mixed with alkalies. The salt was extracted by water and the solution treated with wood ashes. The resulting liquid was then filtered and potassium nitrate was crystallized out of solution.

Potassium nitrate is more serviceable than sodium nitrate since the latter is deliquescent. The sodium salt, therefore, is commercially converted to the potassium salt. This is done by treating the sodium nitrate with potassium chloride.

Nitrites.—In recent years sodium and potassium nitrite have been used as substitutes for or in combination with saltpeter in meat curing mixtures. Sodium nitrite is the one principally used and it is prepared either by reduction of sodium nitrate or as a by-product in connection with the synthesis of nitric acid from atmospheric nitrogen.

Milk and its Products.—Since dried skim milk is a usual ingredient of cooked sausage products, in terms of quantity it is the principal milk product used in the preparation of meat food products. Dried skim milk is the food made by drying sweet skim milk, the skim milk being cows' milk from which the milk fat has been separated. Dried skim milk contains not more than 5 per cent of moisture. Spray drying is the method commonly used in the preparation of edible dried skim milk. There are two systems of spray drying, depending on the method of atomizing the skim milk in the drying chamber. In one system the skim milk is pumped under high pressure through spray nozzles located at the center of air nozzles. This accomplishes an instantaneous drying as the skim milk leaves the nozzle and the dried skim milk falls to the bottom of the drying chamber without appreciable increase in temperature. In the other method which is called the spray wheel system, the drying is accomplished by a centrifugal atomizer revolving at a high rate of speed.

Edible dried skim milk is handled in clean, tight, paper-lined barrels which protect it in transit. Inedible dried skim milk which is principally used as stock feed is shipped and handled as an inedible product, generally in unlined bags.

Skim milk, whole milk, and cream are used in the order named as ingredients of oleomargarine. When used in oleomargarine they are fresh, sweet, and pasteurized.

Cheese, Process Cheese, and Process Cheese Foods.—It is desirable to understand the differences that characterize the several classes of cheese products since they represent differences in moisture content. Those of high moisture content are cheaper products. Therefore, the declaration "Cheese" in an ingredient statement on a label for a meat food product would be inappropriate where process cheese, which is a cheaper product and has a higher moisture content, is used in place of cheese.

Cheddar cheese is the one most commonly used as the cheese ingredient of a meat food product. It contains not more than 39 per cent moisture and its solids contain not less than 50 per cent of milk fat. The milk used in the preparation of cheddar cheese is subjected to the action of harmless lactic acid producing bacteria present in the milk or added to it. Harmless artificial coloring is sometimes added. Sufficient rennet is added to set the milk to a semi-solid mass. At times, some milk is deficient in calcium content. This condition retards its coagulation with rennet. The addition of small amounts of calcium chloride often aids coagulation in such instances. The amount of calcium chloride does not exceed 0.02 per cent, calculated as anhydrous calcium chloride, of the weight of the milk. The mass is cut, stirred, and heated, with continued stirring to promote the separation of whey and curd. The whey is drained off and the curd is matted into a cohesive mass. This mass is cut into slabs which are so piled and handled as to promote the drainage of whey and the

development of acidity. The slabs are then cut into pieces which may be rinsed by sprinkling or pouring water over them with free and continuous drainage. This rinsing is limited to the removal of the surface whey only. The curd making up the slabs is again stirred, further drained, salted, and pressed into forms.

Process cheese or pasteurized process cheese is made by grinding and mixing cheese of the same or more than one variety with the addition of emulsifying agents, salt, water, and coloring, and heating the mixture to make a pasteurized product of uniform texture and composition. The one most commonly used as an ingredient of meat food product is process American cheese which is made from cheddar cheese, washed curd cheese, colby cheese, granular cheese or mixtures of two or more of these varieties. Process American cheese possesses characteristics commonly associated with process cheddar cheese with a maximum moisture content of 40 per cent and cheddar cheese constituting at least 75 per cent of the cheese ingredients.

To accomplish uniform dispersion of the fat in process cheese, certain emulsifying agents are added. Chemicals which have been found suitable for this purpose are monosodium phosphate, disodium phosphate, trisodium phosphate, dipotassium phosphate, sodium citrate, potassium citrate, calcium citrate, sodium tartrate, sodium acid pyrophosphate, tetrasodium pyrophosphate, sodium metaphosphate, and sodium potassium tartrate. These emulsifying agents are used singly and as mixtures and are limited in amount used to 3 per cent of the weight of the process cheese. The efficiency of the action of the emlusifying agent is increased by adjusting the pH of the mix through the addition of lactic acid, citric acid, acetic acid, or phosphoric acid. Reduction of the pH below 5.3 does not improve emulsifying agent action and may alter the characteristic flavor of the product.

Process cheese food is similar in appearance and taste to process cheese and is essentially process cheese to which has been added milk or certain milk products. This addition generally serves to make the process cheese food softer than the corresponding process cheese. Forty-four per cent has been identified as the maximum limit for moisture that will permit sufficient softness but prevent the use of excessive water. In order to maintain an adequate milk weight level, 23 per cent of milk fat is considered the minimum limit. An exception to this is recognized when different flavor characteristics are imparted to process cheese food by adding fruits, vegetables or meats when a minimum milk fat content of 22 per cent is recognized.

Process cheese spreads are another category of cheese product but these spreads are not commonly used as ingredients of meat food products. The soft texture characteristic of process cheese spreads is largely due to the addition of water. The maximum limit of 60 per cent moisture has been recognized. The higher moisture content brings about a reduction in the fat content with a minimum limit of 20 per cent for milk fat being set. Gums or similar water retaining substances are added to the spreads to prevent leakage of water, these include Carob bean gum, gum karaya, gum tragacanth, guar gum, gelatin, carboxy ethylcellulose, carrageen,

oat gum, algin (sodium alginate), and propylene oxide ester of alginic acid. Sweetening agents such as sugar, dextrose, corn sugar, corn syrup solids, maltose, malt syrup and hydrolized lactose are used. The acidifying agents added to process cheese spreads serve purposes in addition to enhancing the action of emulsifiers. They impart a flavor to the spread and also act as preservatives to inhibit the growth of certain bacteria. A lower pH is therefore accomplished which should not drop below 4.

Cereal and Cereal Products.—Wheat.—Flour milling has developed into a vast industry from its beginning centuries ago as a laborious household task. Millstones of various designs were used in flour milling until the invention in 1820 of the steel roller mill which was first used in Switzerland.

In the manufacturing of white flour, the aim is to separate the flour bearing endosperm of the grain from the bran and germ and then pulverize it to small particles. This separation can be accomplished mechanically because of differences in physical properties of the several portions of the grain. The processing steps in flour milling are wheat selection and blending, cleaning of the wheat, its conditioning and tempering, breaking, bolting or sieving, purification of the middlings, and the reduction of the purified middlings.

The miller must select and blend his receipts of wheat if he is to produce a flour of definite characteristics for the particular market that he serves. Each new crop presents special problems which require investigation of the milling and baking qualities of the wheat originating in various producing areas. After blending, the wheat is subjected to cleaning that involves the use of sieves, airblasts, and disk separators. Commercial wheat as it is received at the mill contains various impurities, such as stinking smut, weed seeds, other cereal grains, stones, soil and the like. In some instances the wheat is also washed under a stream of flowing water. After being cleaned, the wheat is conditioned or tempered by adding to it a sufficient amount of moisture to secure maximum toughening of the bran with optimum mellowing of the endosperm. The purpose of toughening the bran is to keep it from pulverizing along with the endosperm during the milling operation. In the presence of excessive moisture, however, the endosperm tends to flake rather than pulverize between the smooth rolls. Normally, hard wheat after tempering contains 15 to 16 per cent moisture.

The breaking of the tempered wheat is carried out by a series of corrugated rolls known as break rolls. A series of six pairs of break rolls is used, each successive pair of rolls possessing an increased number of corrugations and are set more closely together. The rolls operate in opposite directions at a differential in speed of about $2\frac{1}{2}$ to 1. As the rolls turn rapidly toward each other the edges of the corrugation of the more rapidly revolving roll cut across those of the slow roll so that there is a shearing as well as a crushing action on the wheat which falls in a rapid stream between them. The first break rolls are placed some distance apart so that the wheat is only lightly crushed and only a small quantity of fine flour is produced. The coarsest material is conveyed to the second break roll which crushes the material a little finer and this process is repeated until the coarser particles have passed through the six pairs of break rolls.

After each grinding on the break rolls, the crushed material is conveyed

to a sifter or bolter. The sifter or bolter is essentially a large box fitted with a series of sloping sieves. Three general classes of material are separated out by this sieving operation: coarse fragments which are fed to the next succeeding break rolls until only bran remains; fine particles of flour which pass through the finest flour sieve; and granular particles of intermediate size that are called middlings. These middlings consist of fragments of endosperm mixed with small particles of bran and released embryos. They are an entirely different wheat product from the cattle feed known as middlings.

The middlings are subjected to a process called purification which separates the branny material from them. The purified middlings are then ground to flour between smooth rolls called reduction rolls which revolve at a differential of about $1\frac{1}{2}$ to 1. These rolls pulverize the endosperm fragments and flake the remaining bran fragments. By a series of rolling and sieving the flaked bran chips are removed from the pulverized endosperm. There remains after separating out the pulverized endosperm the very fine middlings and bran with a little germ. This constitutes feed middlings.

In a large mill there may be as many as 30 varieties of pulverized endosperm or flour. All these combined are known as straight flour. Frequently, the more highly refined flours are separated out and sold as patent flours while the remaining are known as clear flours. The percentage of the total flour merchandised as patent flour varies widely. When a high percentage of the more refined flours are sold as patent flours, the quantity of the remaining or clear flours becomes lower. Freshly milled wheat flour contains small quantities of yellow pigment that impart to it a creamy to yellow hue. Storing such flour at moderate temperatures accomplishes a natural aging which improves its color as well as its baking quality. Small quantities of oxidizing agents are added to freshly milled flour to bleach it and accomplish a rapid artificial aging effect. These agents include oxides of nitrogen, chlorine, nitrosyl chloride, chlorine dioxide, and benzoyl peroxide. One part by weight benzoyl peroxide is mixed with not more than six parts by weight of one or any mixture of two or more of the following: potassium alum, calcium sulfate, magnesium carbonate, sodium aluminum sulfate, dicalcium phosphate, tricalcium phosphate, starch, and calcium carbonate.

Macaroni Products.—Macaroni, spaghetti, and vermicelli are classed as macaroni products. They are prepared by drying formed units of dough made from semolina, durum flour, farina, flour, or any combination of two or more of these with water or with or without one or more of the following: egg white, disodium phosphate, salt, gum gluten, and flavoring such as onions, celery, garlic, and bay leaf.

The dough is kneaded into a stiff plastic mass which is translucent in thin layers and generally creamy yellow in color. The dough is transferred from the kneader to a large vertical press in the bottom of which the appropriate die or perforated plate called the trafila is located. In the preparation of the macaroni, each hole in the die has a centrally located steel pin which forms the hole in the macaroni. As the piston descends the dough is forced through the die at a pressure of from 2,500 to 5,000

pounds per square inch. Drying and curing is the most critical stage in the manufacturing process of macaroni products. The modern practice employs air currents of regulated temperature and humidity with the drying being completed in thirty-six to ninety hours. Macaroni is generally more than 0.11 inch in diameter but does not exceed 0.27 inch.

Spaghetti may be tubular but it is generally cord-shaped (not tubular) and it is not more than 0.11 inch in diameter but not less than 0.06 in diameter. Vermicelli is cord-shaped and not more than 0.06 in diameter.

Noodle Products.—This class includes noodles, egg noodles, egg macaroni, egg spaghetti, and egg vermicelli. These products are also prepared by drying formed units of dough made from semolina, durum flour, farina, and flour, but may also contain egg products in addition to water, salt, gum gluten, and flavorings such as onions, celery, garlic, and bay leaf. Noodles and egg noodles are prepared in ribbon shape while the shape and size of the egg macaroni, egg spaghetti, and egg vermicelli are the same as the products prepared without eggs and classed as macaroni products.

Corn.—White cornmeal is prepared by grinding cleaned white corn to a degree that the crude fiber content of the finished cornmeal is not less than 1.2 per cent and not more than that of the cleaned corn from which the meal was ground. The moisture content of the cornmeal is not more than 15 per cent, and its fat content does not differ more than 0.3 per cent from the corn used in the grinding process. The crude fiber and fat content represented by these figures is calculated on a moisture-free basis for the meal.

Yellow cornmeal meets the same standard as white cornmeal except that cleaned yellow corn is used instead of white corn.

Two methods of grinding corn for human consumption are used called the old process and the new process. Old process meal is also known as water-ground meal because the mills making it were formerly operated by water power. In the old process the corn (preferable white dent) is ground to a coarse meal between millstones running slowly at a low temperature. The meal is softer and more flour-like than the more highly refined new process meal. The new process is carried out with steel rolls that mill the corn along lines similar to that employed in milling wheat.

Soya Flour.—With the perfection of processes for the preparation of edible milled products derived from the extracted soy bean flakes, soya flour became available in large amounts for use as an ingredient of many foods including meat food products. Although soya flour does not possess binding qualities characteristic of cereal flours, it has good moisture absorbent powers and blends nicely with meats and meat by-products.

The objective of the processing method employed in the preparation of edible soya flour is to produce an extracted flake free of bitterness and a beany taste. Decorticated beans are used since the shell imparts an undesirable taste to the finished product. An alcohol extraction method has been developed to replace the one using petroleum factors. The soy bean flakes from which the oil has been extracted by ethyl alcohol have an improved color and possess less of the bitter and beany taste. The extracted flakes are subjected to a degree of heating that partially toasts them for the purpose of removing all traces of the solvent and to destroy all vestige

of bitter or beany flavor. The resulting soya flour comes as near to being tasteless as can be accomplished by the method of processing.

So-called soya grits are also sometimes used as an ingredient of meat food products. Soya grits differ from soya flour only in the degree of milling.

Vegetables.—Fresh, dehydrated, and canned vegetables are used in large quantities in a great variety of meat food products, such as meat stews, soups, meat loaves, chili con carne with beans, and corned beef hash. They are so handled preparatory to their being used as ingredients of meat food products to assure their cleanliness, wholesomeness, and freedom from deterioration and adulteration.

Fresh Vegetables.—These are first sorted to eliminate those that are wilted, rotten, moldy, decayed, worm-infested, or discolored. The remaining portion is washed thoroughly in running water and then passed across a table where the vegetables are again examined to detect and remove, usually by trimming, any unfit portion.

The peeling of potatoes is done mechanically when large quantities are used as, for example, as an ingredient of corned beef hash. The methods of mechanical peeling usually used are the abrasive peeler, the flame peeler, and the lye or caustic soda method. The machine used for abrasive peeling consists essentially of an abrasive-lined drum. The floor plate of this drum revolves at a regulated speed and the drum is provided with water sprays. The potatoes are dumped into the drum and the revolving floor plate pushes the potatoes against the sides of the abrasive walls. A flow of water flushes the removed skin through a waste drain opening at the bottom. There is a continuous type of abrasive peeler in which the potatoes pass through a winding course and over the abrasive sides of rotating cylinders. The peeling and trimming loss of potatoes when the abrasive method of peeling is used may run higher than 20 per cent.

Due to the high loss experienced with the use of the abrasive peeler, another method of peeling was devised in which the potato is first subjected to the action of a boiling hot, saturated salt brine solution after which it is flamed at a temperature of around 2,000°F. for a period of from fifteen to thirty seconds. The charred surface of the potato is removed by scrubbing and washing resulting in a clean, peeled product.

The lye or caustic soda peeling results in even smaller loss. The potato is submerged in a hot solution of lye for a short time after which it is washed with acidulated water until all the lye is removed. Then the potato is scrubbed and washed removing all of the peel.

The peeled and cleaned potatoes are passed across a work table where the residual skin is removed along with the eyes, discolored areas, insect injuries, and the like.

Dried Beans.—As they are distributed in the trade dried beans contain varying amounts of silt, stones, pods, hulls, and stems. These are removed as part of the preparation necessary for using the dried beans as an ingredient of a meat food product. They are washed thoroughly with running water as they pass through a revolving perforated cylinder that permits the silt and smaller particles of foreign matter to pass off with the wash water. Then the beans pass through a chamber of flowing water in which baffles are so located as to trap the stones which are heavier than the beans.

At the same time the lighter particles, such as pods, hulls, and stems are floated off with the waste water. After this the beans are again passed through a perforated cylinder where they are flushed with running water as the final cleaning and any remaining foreign particles are removed here.

Dehydrated Vegetables.—The dehydration of vegetables, in addition to their sorting and cleaning, consists of cutting the vegetables to the desired size and shape, blanching with steam or water, or a combination of these at boiling temperatures, to destroy enzymatic action, sulfuring with sulfur dioxide to retain high quality of product during high drying temperatures, and the process of drying.

Dehydrated potatoes are the principal dehydrated vegetable used as an ingredient of a meat food product since they are commonly used in place of fresh potatoes in preparing corned beef hash. For dehydration, many operators prefer the type of potato that becomes white and mealy with cooking.

The storage temperature of 40°F. is low enough to keep mature potatoes dormant three to five months. However, the potato may become mildly sweet under this storage condition. At lower temperatures the potatoes may show a marked yellowing and browning at the center of the piece after being dehydrated. To correct the effects of such storage conditions, the potatoes are held at temperatures of around 60°F. for approximately a month prior to dehydration during which time the sweet taste is lost and the potato loses that characteristic that produces a discolored dehydrated article. A great number of factors in addition to storage conditions affect the quality of the dehydrated potato product. Its color and texture are influenced by the maturity of the raw potato, the time and method of blanching, drying conditions, and method of rehydration. Producers of dehydrated potato products conduct tests for rehydration and quality on each lot of potatoes. An acceptable product should be rehydrated to a satisfactory plumpness without becoming mushy or watery. The rehydration weight generally runs from 2 to 4 times the dried weight for diced or cubed pieces and 3 to 5 times for julienne strips.

Canned Vegetables.—Canned tomato products exceed in volume all other canned vegetables used as ingredients of meat food products. The definitions and standards of identity for canned vegetables promulgated by the Federal Food and Drug Administration serve as guides in eliminating inferior canned vegetables from use in meat food products. These standards are published under Title 21 of the Code of Federal Regulations.

Vegetable Oils.—Large quantities of vegetable oils are used in the meat packing industry to blend with animal fats in the preparation of shortenings and oleomargarine. These oils may come to the meat packing plant as refined oils or in the crude form for refining on the premises of the plant where they are to be used. They include cottonseed oil, soy bean oil, peanut oil, sesame oil, and coconut oil.

Oil Bearing Materials.—The kernels of the nut of the palm, Cocos nucifera, are the source of coconut oil. This palm grows along the coastline of practically all the tropical regions. The kernel has a high moisture content which is favorable to enzymatic action on its fat content. Hence, it must be processed promptly if it is to yield an oil of low free fatty acid

content. Copra is the dried meat of the kernel from which the coconut oil of commerce is expressed. The kernels separated from the husks are split in half after draining off the milk; they are then exposed to the sun until the concentration of the meat of the kernel permits it to be readily removable from the shell. The separated meat is then further dried until the moisture content of the copra is reduced below 8 per cent. Properly prepared copra that is stored in dry, well-ventilated buildings will remain in good condition for some time.

Oil bearing seeds are much less subject to deterioration than the materials of high moisture content, and under suitable conditions may be stored for long periods before they are processed. However, there is a critical moisture level above which oil seeds do not keep well. Accordingly, most mills are equipped with driers to reduce the moisture content of oil bearing seeds before they are put into storage.

Oil bearing seeds whose cell structure has been damaged develop free fatty acids very rapidly. Rolled cottonseeds deteriorate markedly within a few days or even hours. Also, undecorticated seeds have much better storage properties than decorticated seeds.

Partial hydrolysis of the oil is not the only deteriorative change affecting the oil in oil bearing seeds. Other changes involve the non-oil constituents of the oil that may affect the quality of the oil. In both cottonseed and soy beans there is an increase of oil-soluble pigments which are difficult to remove in the refining and bleaching. There are also changes involving the solubilization of phosphatides or other surface active substances in the oil possibly from the splitting of protein-phosphatide complexes which may increase the refining loss out of proportion to the increase in free fatty acids. There are beneficial changes that occur in soy beans during a period of storage. The yield of oil from newly harvested soy beans is less than that obtained after a period of storage. During the storage of soy beans there is a diminution in their chlorophyll content. Chlorophyll in the oil is undesirable because of the difficulty of removing green color in subsequent processing and it becomes intensified by hydrogenation.

Preparation of Oil Bearing Materials for Oil Extraction.—When practical it is preferred to decorticate oil bearing seeds before they are extracted. The hulls are low in oil content and if they are not removed from the seed they tend to reduce the total yield of oil by absorbing and retaining oil in the press cake and, in addition, they reduce the capacity of the extraction equipment. Incident to their decortication the seeds are freed from dirt, sticks, leaves, and assorted trash.

Soybeans are not decorticated before they are processed for oil unless the meal is intended for human consumption. The hulls of soy beans constitute but a small part of the seed and they are relatively non-absorbent. Small oil seeds, such as flaxseed and sesame seed, are also processed without decortication.

The extraction of oil from the seeds either by mechanical expression or with the use of solvents is facilitated by reducing the seed to small particles. Rolls are generally considered to be the best type of mill for use in reducing the seeds prior to their extraction. Smooth rolls which reduce the oil seeds to thin flakes are considered most satisfactory for

hydraulic pressing while flaking rolls are considered best for solvent extraction.

Cooking the oil bearing seeds causes them to yield up their oil more readily. The reason for this has not been completely explained since the changes brought about by cooking are complex both chemically and physiochemically. The oil droplets in cottonseed, for example, are almost microscopic in size and are distributed throughout the seed. One effect of cooking is to cause these droplets to coalesce into drops large enough to flow from the seed. The denaturing of the proteins by the heat and the influence of the cooking on the surface activity of the material are other factors.

Mechanical Expression of Oil.—The oldest and most common method of oil extraction consists of applying pressure to batches of oil bearing material confined in bags, cloths, cages, or similar devices. The pressure is applied by levers, wedges, screws, hydraulic systems, and so forth.

This type of press is giving way in the United States to presses of the expeller or screw-type which are used almost exclusively for the mechanical extraction of soy bean oil. Presses of this type are continuous and, in most respects, automatic in operation. The expeller is essentially a continuous cage press in which pressure is developed by a continuously rotating worm shaft. An extremely high pressure ranging from 15,000 to 20,000 pounds per square inch is built up in the cage or "barrel" through the action of the worm working against an adjustable pressure orifice or choke, which constricts the discharge of cake from the end of the barrel. The interior of the barrel of this machine is made of flat steel bars, which are set edgewise around the periphery of the barrel, and are held in place by a heavy cradle-type cage. The openings between the barrel bars, through which the oil must flow, can be adjusted by changing the thickness of the spacers between the bars.

Solvent Extraction of Oils.—Extraction with solvents obtains the best oil yields when the oil bearing material has a fairly high solids content. This method is relatively more advantageous in the processing of soy beans because of their comparatively low oil content. Also, soy beans can be rolled to thin, coherent flakes which are well- adapted to solvent extraction.

Light petroleum fractions obtained from natural gas are the most commonly used solvents. They are used both for batch extraction and in connection with continuous extraction methods.

Refining.—The crude oils produced by either the expression or solvent extraction method contain variable amounts of non-glyceride impurities. For example, the following have been reported as occurring in crude cottonseed oil: raffinose, pentosans, resins, proteoses, peptones, phospholipins (phosphatides), phytosterols, phytosteroline, inosite phosphates, tocopherols, xanthophyll, chlorophyll, carotenoid pigments, mucilaginous substances, and free fatty acids.

Not all of the impurities in crude oils are undesirable. The sterols, for example, are colorless and heat stable and for all practical purposes inert. Furthermore, the tocopherols perform the important function of protecting the oil from oxidation. However, most of the other impurities are objectionable. The object of refining is to remove the impurities in the oils

with the least damage to either the glycerides or the tocopherols or other antioxidants.

Certain oil impurities, such as phosphatides, proteins, or protein fragments and gummy or mucilaginous substances, are soluble in the oil only in an anhydrous form and can be precipitated and removed if they are hydrated. The water washing or degumming process is similar to continuous alkali refining except that warm water is used in place of the alkali. The water and the oil to be washed are emulsified together in a continuous mixing device. After a suitable holding time, the hydrated substances and the excess water are removed by continuous centrifugation.

By far the most important and generally practiced method of refining is with the use of an alkali. Alkali-refining effects an almost complete removal of free fatty acids which are converted into oil-insoluble soaps. Other acidic substances likewise combine with the alkali and there is probably some removal of impurities from the oil by absorption on the soap formed in the operation. Also, all substances are removed which become insoluble from hydration. The alkali most commonly employed for refining oils is caustic soda.

Continuous centrifugal refining has come into wide use in the United States. In this system a continouus stream of oil and lye is fed into emulsifying chambers. The emulsion is then broken by heating it quickly to 140°F. causing it to separate into soap stock and oil which are carried to a high speed centrifuge. The oil as it comes from the centrifuge contains a small amount of dissolved and suspended soap and water. This oil is then washed by mixing it with an amount of hot water equal to 10 per cent of its own weight and this mixture is heated to a temperature of 150° to 180°F. This mixture is passed through a second centrifuge. The washed oil runs to a receiving tank and the weak soap solution is discharged into the sewer. This washing operation is sometimes repeated.

Bleaching.—The object of bleaching is to remove coloring materials which are relatively unaffected by refining. This treatment usually consists of bringing the oil into contact with a solid adsorbent which has an affinity for the coloring materials. These adsorbents usually consist of bleaching clay (fuller's earth) and activated carbon. Chemicals that have the capacity of oxidizing pigments to colorless forms are not used in bleaching edible oils since such chemicals also tend to oxidize and destroy the antioxidants in the oil.

Deodorization.—If deodorization is properly carried out the removal of odoriferous constituents from oil is substantially complete. Steam is used to remove odors from oils because of the great differences in volatility between the triglycerides and the substances which give oils and fats their natural flavors and odors. Steam deodorization is essentially a process of steam distillation wherein relatively volatile odoriferous and flavored substances are stripped by the steam from the relatively non-volatile oil. The operation is carried out at a high temperature to increase the volatility of the odoriferous components. The application of reduced pressure during the operation protects the hot oil from atmospheric oxidation and prevents undue hydrolysis of the oil by the steam.

The concentration of odoriferous substances in an oil is generally quite

low. In the case of common oils such as cottonseed oil, peanut oil, and soy bean oil it does not appear to be greater than about .10 per cent. Hydrogenation of an oil imparts a decided flavor and odor. This odor appears to be characteristic of the hydrogenation reaction as it is similar for different varieties of oil and is developed even in oils which have been thoroughly deodorized previous to hydrogenation.

Deodorization destroys any peroxides in the oil and removes any aldehydes or other volatile products which may have resulted from atmospheric oxidation. However, strongly rancid oils cannot be completely deodorized.

Deodorization is usually carried out in closed vertical cylindrical steel vessels with conical or dished bottoms. The oil in the tank is brought to a temperature of 450°F. and approximately 8 feet of head space is allowed in the deodorizer to avoid the splashing of oil over into the vapor line while it is being agitated during the process. A steam distributor is installed in the bottom of the deodorizer for breaking up and distributing the flow of injected steam. The injection of steam through the oil in the deodorizer which is under vacuum results in considerable rolling and splashing of the oil. The vapor line leading off from the top of the deodorizer is connected with a multistage system of steam ejectors which creates the vacuum.

Mono- and Diglycerides.—Oils and fats may be defined as those substances of plant or animal origin which consist predominantly of triglyceryl esters of the fatty acids or triglycerides. They contain three fatty acid radicals. If the three fatty acids are identical, the product is a simple triglyceride. If they are different it is a mixed triglyceride. The glycerides of fats are generally highly mixed. Monoglyceride and diglyceride contain but one and two fatty acid radicals respectively, and consequently have free hydroxyl groups. They occur naturally only in fats which have been partially hydrolyzed but they are easily prepared synthetically.

Monoglyceride and diglyceride are added to shortening to give it superior emulsifying properties. They possess marked surface activity due to their content of both lipophilic (fatty acid) and hydrophilic (hydroxyl) groups. The addition of mono- and diglycerides to shortening promotes its dispersion in the baker's doughs, particularly those with a high content of sugar.

Lecithin.—This is a kind of phosphatide and is one of the materials commonly removed in refining certain crude seed oils. Most of the phosphatides of commerce are derived from soy bean oil and are marketed as "soya lecithin." It is usually a stiff, waxy, dark yellow or orange-brown material containing about 30 per cent of free soy bean oil. Structurally, the phosphatides consist of triglycerides in which one fatty acid radical has been replaced with phosphoric acid. In the case of lecithin the phosphoric acid is further esterified with choline. The lipophilic portion of the molecule consists of the fatty acid radicals while the phosphoric acid-choline or phosphoric acid-cholamine complex comprises the hydrophilic group.

The phosphatides are classed with the surface active agents derived from fats and are natural rather than synthetic products. The commercial lecithins are effective oil soluble emulsifying and dispersing agents. They

are used as emulsifying and anti-spattering agents for oleomargarine. Lecithin is also used as an emulsifying or surface active agent in shortening and lard. In shortenings and lard it is also a convenient oil soluble anti-oxidant of the acidic type.

Artificial Colors.—**Coal-tar Dyes.**—In accordance with provisions contained in the Food, Drug and Cosmetic Act of 1938, the Food and Drug Administration of the Federal Security Agency has worked out a procedure that assures the use in food of only those coal tar colors that are harmless and suitable for the purpose. The Administration maintains a list of approved coal tar colors for food and it provides a certification service for batches of any of the colors so listed that are prepared for distribution and sale to food processors.

When the manufacturer of a coal tar color desires to obtain listing for a particular color with the Food and Drug Administration, his request is accompanied with pharmacological data showing that the color is harmless and suitable for the use for which it is proposed, and chemical data showing methods for determination of the identity and purity of the color. A 5-pound sample of the color produced under practical manufacturing conditions is furnished along with the request for listing and an advance deposit of $500 is made.

If, after adequate investigation, it is found that the color is harmless and suitable for the purpose for which it is proposed and proper methods are available for determining its identity and purity, an amendment to the Administration's color regulations is proposed and a public hearing is held. Based on the evidence given at such a hearing, the requested listing is either made or denied.

Each batch of a listed color which is manufactured is required to be certified before it can legally be used in a food. The Administration's certification issues only after a thorough examination of a sample from the batch shows that it meets prescribed standards of purity. Listing and certification are therefore an assurance of two things, (1) that the dye itself is harmless and (2) that the particular batch is free from harmful impurities.

The general requirements for certification by the Administration of a batch of coal tar color intended to be used in coloring foods are:

1) Freedom from all impurities to the extent that such impurities can be avoided in good manufacturing practices.

2) It must be a listed coal tar color.

3) It does not contain more than 0.00014 per cent arsenic, 0.0001 per cent of lead, and a trace of heavy metals.

If a sample representing a batch of listed coal tar colors is found after adequate investigation by the Administration to comply with its requirements, the Administration issues a certificate covering the batch in question. This certificate assigns a lot number to the batch and shows the pure dye content found in the batch.

The following information is required to be contained on the label for a coal tar dye intended to be used as a food coloring:

1) An accurate statement of the net contents of the package.

2) The name and place of business of the manufacturer, packer or distributor.

3) The name of the color components and that of each diluent contained in the mixture.

4) The name of the color.

5) The lot number of the batch.

6) The pure dye content of the color.

7) In the case of a color certified for only a limited use a statement setting forth this limitation.

The person to whom the certificate is issued is required to keep records to show the quantity of color used, the date, and kind of use, and the shipping records including the name and address of the person to whom shipment was made. This information is required to be produced at the request of a representative of the Food and Drug Administration until one year after disposal of the batch.

The following coal tar colors are commonly used in the meat packing industry and are listed as approved by the Food and Drug Administration:

F D & C Orange #1 (Orange 1), F D & C Red #1 (Ponceau 3 R),

F D & C Red #2 (Amaranth), and F D & C Red #3 (Erythrosine).

Vegetable Coloring.—*Alkanet.*—Alkannin is the coloring principle of alkanet root and is brownish-red in color with a coppery luster. It is almost insoluble in water but is soluble in alcohol, ether, or fixed oils. The alkannin is found most abundant in the cortical region of the alkanet root. The root is obtained from a herbaceous perennial plant indigenous to Asia Minor and southeastern Europe.

Annatto.—This is a brownish-red color derived from the reddish pulp surrounding the seeds in the fruit of Bixa orellana L., a medium-sized tree native to northern South America but widely cultivated in tropical Asia and Africa. The coloring principle does not dissolve in water but imparts to it a yellow color. It is soluble in alcohol, oils, and alkaline solutions. It contains two coloring principles, one known as bixin, which when pure is dark red and the other is a yellow coloring matter, orellin, which is probably a decomposition product of bixin.

Cochineal.—Cochineal solution is obtained from an insect indigenous to Mexico, Peru and Central America that has the general appearance of a wood louse. The red dye is found in the dried remains of the female insect. Cochineal solution is very dark purplish-red in color. This changes to orange upon being acidified with hydrochloric acid and returns again to red purple upon being made alkaline.

Saffron.—The chief coloring agent in saffron is the glycoside crocin. This is a yellow powder easily soluble in water. Saffron is a perennial plant, Crocus sativus. The plant is believed to be a native of Greece, Persia, and Asia Minor. At present, saffron is chiefly cultivated for medicinal use in Spain. In the United States it is cultivated as a garden flower.

Turmeric.—Turmeric yellow or curcumin is obtained from the rhizome of the Curcuma longa L. which is a plant native to southern Asia and the East Indies but now cultivated particularly in China, Bengal, and Java. Turmeric is used for dyeing yellow but the color is not permanent.

Chemical Preservatives.—Historically, the use of chemical preservatives in foods has been supported and condemned by many authorities. Out of its checkered career has emerged what appears to be a sound philosophy

that begins by distinguishing between those substances that are chemical in nature but which serve traditionally as flavoring and processing materials, and chemicals whose only use is to inhibit deteriorative changes in food. Reserving the designation chemical preservatives to identify those chemicals that serve only to retard deteriorative changes in food, there is identified a class of substances which is subject to definite rules for controlled use. Generally speaking, their rigid control is justified because they are used as a substitute for clean and careful food processing practices and they tend to mask inferiority; furthermore there is insufficient knowledge concerning their complete mode of action. In recent years the only chemical preservatives that have gained acceptance for use in products of the meat packing industry are benzoic acid and sodium benzoate in oleomargarine and a number of antioxidants in shortenings and rendered fats.

Benzoic Acid and Sodium Benzoate.—The Wiley report of 1908 pointed up a controversy that had developed between food manufacturing interests and food control officials concerning what had become a rather prevalent practice of using chemical preservatives in foods prior to that time. Mr. Wiley's campaign against the use of chemical preservatives in foods emphasized the consumer demand for cleanliness in food preparation accompanied with proper processing methods. Benzoic acid and sodium benzoate became the center of controversy, with Mr. Wiley concluding on the one hand that they are highly objectionable and poisonous, while the Remsen[1] Referee Board Report of 1909 concluded that they are relatively harmless. Although benzoic acid and sodium benzoate were permitted to be used in all meat food products prepared under Federal meat inspection until 1948, these preservatives had only a very limited use. By regulation in 1948 their use is limited to oleomargarine. The acidity of the medium in which these preservatives work is very important. Their usefulness in meats at the usual range of pH for fresh meats is highly questionable.

Antioxidants.—When fats are exposed to the air they tend to oxidize and produce the condition called rancidity. This condition is accompanied with typical off odors and flavors produced by the oxidation. All fats have this tendency to become rancid but there are factors which influence the rate of occurrence. Some of these factors are the chemical composition of the fat, the method of processing, the method of packaging, the conditions of storage, and the presence or absence of naturally occurring antioxidants in the fat. Antioxidants are substances which when present in fats will delay the onset of rancidity. They stabilize the fat toward oxidation. Some fats, such as certain vegetable oils, contain naturally occurring antioxidants. Other fats, such as lard, contain very little antioxidant material. Synergists are used in combination with the antioxidants to improve their efficiency.

Lecithin.—This is one of the phosphatides naturally occurring in crude vegetable oils. It is only moderately active as an antioxidant. It is inexpensive and relatively easily mixed with the rendered fat. The maximum

[1] I. Remsen "Influence of Sodium Benzoate" United States Department of Agriculture Report No. 88 (1909)

stability effect of lecithin is accomplished with 0.075 per cent of the lecithin in the rendered fat.

Resin Guaiac.—This is also relatively inexpensive and may be used in concentrations up to 0.10 per cent. It is a rather effective antioxidant and possesses the outstanding advantage of its antioxidant effect carrying over into the baked and fried goods made from the treated fat. Resin guaiac has several disadvantages, however. Some of these are its odor and flavor which must be removed by deodorization of the treated fat. It is also quite insoluble in the fat which presents the problem of incorporating it uniformly in the treated fat.

Resin guaiac exists as a physiological product filling up the tissues of the wood of Guajacum officinale, a middle-sized or low evergreen tree indigenous to the West Indies and the northern part of South America. It is obtained in several different ways, the most simple is by spontaneous exudation.

Tocopherols.—Tocopherols, or vitamin E, are very effective stabilizers for fats. They are easily mixed with the rendered fat and they do not impart any color, odor, or flavor. They occur naturally in crude vegetable oils and are produced as part of the refining process. Concentrations of tocopherols up to 0.03 per cent of the rendered fat are used.

Nordihydroguaiaretic Acid.—This is a very powerful antioxidant in rendered fats. It is colorless and it imparts no odor or flavor to the treated fat at the permitted concentrations of 0.01 per cent. Disadvantages of this antioxidant are that it is quite expensive and its effect does not carry through to any appreciable extent into the foods prepared with the treated fat.

Nordihydroguaiaretic acid was discovered at the University of Minnesota in 1942. It is extracted from the creosote bush which is indigenous to semi-arid areas in parts of western United States.

Propyl Gallate.—This is the propyl alcohol ester of gallic acid and is a very effective antioxidant in rendered fats. It is used in concentrations up to 0.01 per cent. Its stabilizing action does not carry over into the baked goods prepared with the treated fat, due, probably, to its solubility in water. It is heat stable and deodorization does not lower the stability of fats to which it is added. Propyl gallate does not affect the color of the rendered fat to which it is added nor does it impart odor or flavor to the fat.

Thiodipropionate Group.—Thiodipropionic acid, dilauryl thiodipropionate, and distearyl thiodipropionate, singly or in combination in quantities up to 0.01 per cent of thiodipropionic acid and 0.09 per cent of either dilauryl thiodipropionate or distearyl thiodipropionate, or combinations of the two in rendered fat, are effective antioxidants. The esters are more fat soluble than the acid and their effect carries over into the products prepared with the treated fat. This carry-over effect has not been experienced with the acid. When the rendered fat is to be deodorized, the esters should be added after completion of the deodorization. On the other hand, the acid should be added to the fat prior to deodorization so that it may be present during that process.

Butylated Hydroxyanisole.—This is a mixture of 2-tertiarybutyl-4-hydroxyanisole and 3-tertiarybutyl-4-hydroxyanisole and is an effective antioxidant in rendered fat when used in amounts up to 0.02 per cent.

Citric Acid and Phosphoric Acid.—These are not true antioxidants, however, they are added to rendered fats for their synergistic effect. They improve the stabilizing activity of the antioxidants normally present in the rendered fat as well as the added antioxidant. Since lard, for example, contains little or no naturally occurring antioxidants, the addition of citric acid or phosphoric acid has no value. On the other hand, their addition to vegetable oils which contain natural antioxidants or rendered animal fats to which antioxidants have been added has an improved stabilizing effect.

Chapter

10

PREPARATION OF MEAT AND MEAT FOOD PRODUCTS

Wholesome, disease-free meat and meat by-products move from the inspected slaughtering department to the processing departments of the meat packing plant. Where the inspection supervision is adequate, the processing departments are so constructed, equipped, and maintained as to assure a clean and sanitary environment for the processing of the meats and meat food products.

Additional inspection supervision is necessary, however, to assure that the processes employed are those that are normal for the particular products. The process of manufacture is not permitted to impair the wholesomeness of the product. It must not result in its adulteration, either by adding a substance not normal to the product or by failure to remove a substance normally removed during the process of manufacture. Furthermore, the process is not permitted to impart a deceptive character to the finished product.

To accomplish this, it is necessary that the inspector know what is the normal process of manufacture for each product and that he is alert to those steps in the processing of the particular product where deviations from the normal might occur. With this knowledge he is able to plan his inspection routine so that it may be an efficient one and result in an effective supervision over the handling, processing and packaging of the meats and meat food products preparatory to their being shipped to the trade.

Chilling.—It is common knowledge that meat will not keep for a long time unless it is thoroughly chilled. Fresh meat, therefore, is chilled so that a temperature just above freezing is attained in all parts of the article. This temperature is maintained throughout the meat until it is either delivered to the consumer or it enters into a process of manufacture. At temperatures below freezing, for example, 15°F., meat will keep for a long time in excellent condition. This temperature, however, imparts a hard, frozen condition in the meat which, upon thawing produces characteristics of the meat that are considered less desirable than those possessed by properly chilled meat that has not been frozen.

The properly dressed animal carcass as it is placed in the refrigerated compartment from the slaughtering department is warm and moist. It offers ideal conditions for the growth and multiplication of spoilage organisms. In fact, there is a slight rise in the temperatures of the heavy tissues after death. This is due to the heat generated by the glycogen-lactic acid

reaction which has as one of its results the lowering of the pH of the muscle tissue.

Quick chilling of the carcass is imperative in order to check and prevent the growth of spoilage organisms. It was once thought that a carcass could be chilled too quickly. It was believed that if the animal were chilled too quickly a sort of casing would be formed on the outside of the carcass that would cause the animal heat to remain in the carcass by interfering with an interchange of the animal heat with the refrigerated atmosphere surrounding the carcass. It is now generally conceded that there is no such thing as chilling the carcass too quickly provided no portion of it is frosted. The best practice now is to chill carcasses to an internal temperature of 34° to 36°F. as soon as possible. The underlying principle of quick chilling is rapid circulation of air at low temperature and controlled humidity. A temperature as low as 20°F. is sometimes used in chilling heavy beef carcasses. As the chilling of the carcass progresses the surrounding temperature is, of course, adjusted so as to prevent freezing the meat.

Rapid chilling of the meat has the objective of inactivating the spoilage organisms during the initial stationary phase of their development and the lag phase during which the organisms begin to divide slowly before the logarithmic phase which is the period of most vigorous growth. It may be that such chilling also effects a cold shock on the spoilage organisms in the meat. Although this has not been worked out conclusively, there is indication that such cold shock actually reduces the number of organisms present.

Cutting.—The dividing of the chilled animal carcass into its various commercial parts is generally referred to as the cutting operation. The products of the cutting department move in several directions—the fats to the rendering department, fresh cuts of meat directly to the trade, fresh cuts of meat to the curing department, and other meat is processed into many kinds of sausage products, so-called delicatessen products and jarred and canned foods.

Figures 67 to 74 require very little explanation. The charts showing the location and names of bones with relation to the commercial subdivisions of the carcasses of the several species are useful because it is important to be able to visualize the bone structure where the dividing cut is made. Also it is useful to know the bone content of each cut.

The beef fillet from which the fillet mignon is prepared is not illustrated among the wholesale cuts on the beef chart (Fig. 71). This fillet consists of the psoas major and psoas minor muscles. When this cut is removed from the loin it cannot be used for sirloin steaks, porterhouse, and T-bone steaks. The loin is then called a shell and the steaks cut from the shell contain only the so-called tail of the steak and the meat dorsal to the transverse process of the lumbar vertebra.

Freezing. A temperature of 15°F. was used for freezing and storing meats until the early 1900's. With the development of better refrigeration equipment and insulation, and the recognition that good quality of the meat is retained at lower temperatures, the freezing of meat is accomplished in air temperatures of 10°F. and lower in a rapid movement of air. After freezing, the meats are stored in temperatures of 0°F. or lower.

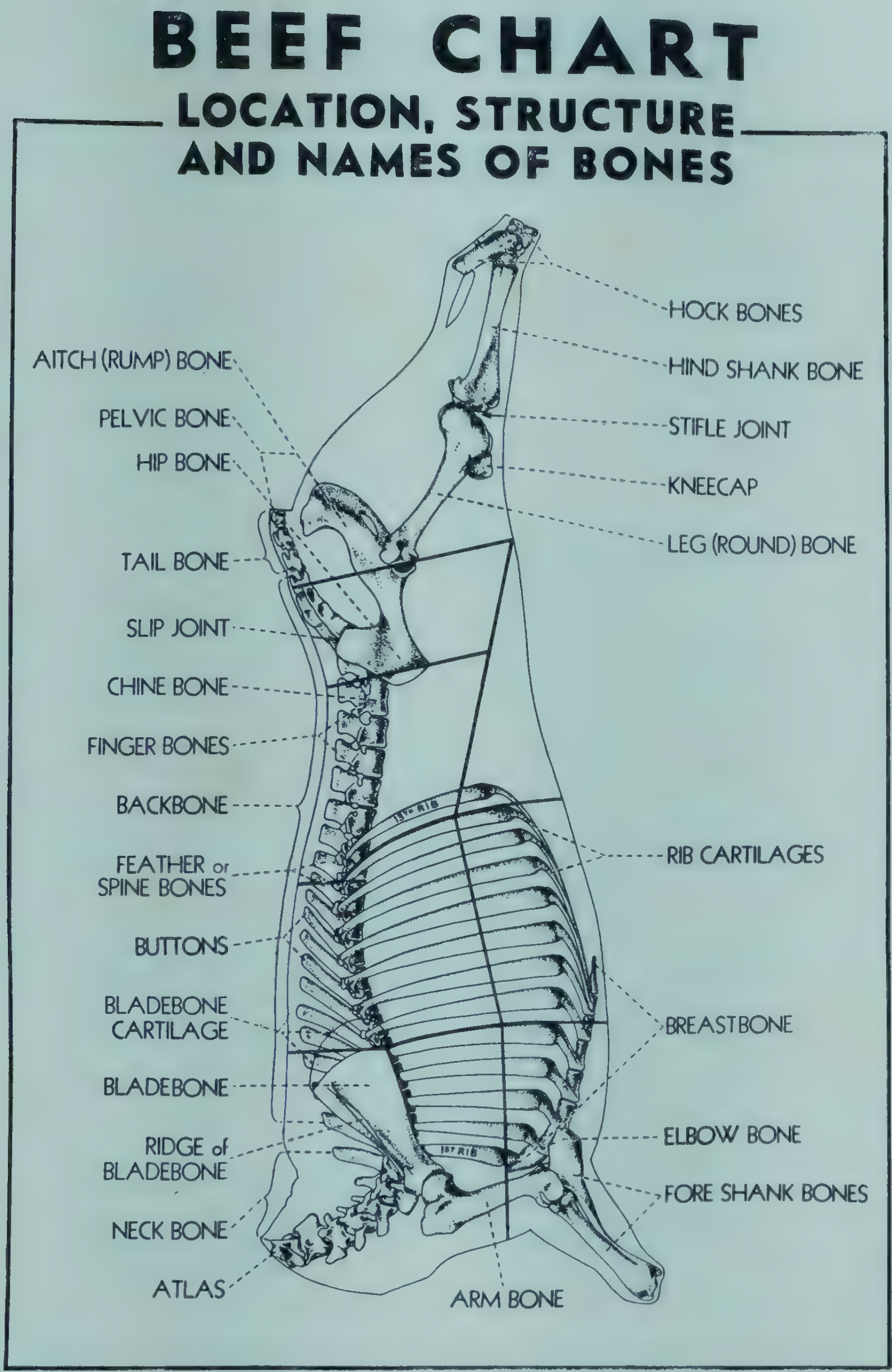


FIG. 67.—Beef chart, location, structure and name of bones. (National Live Stock and Meat Board.)

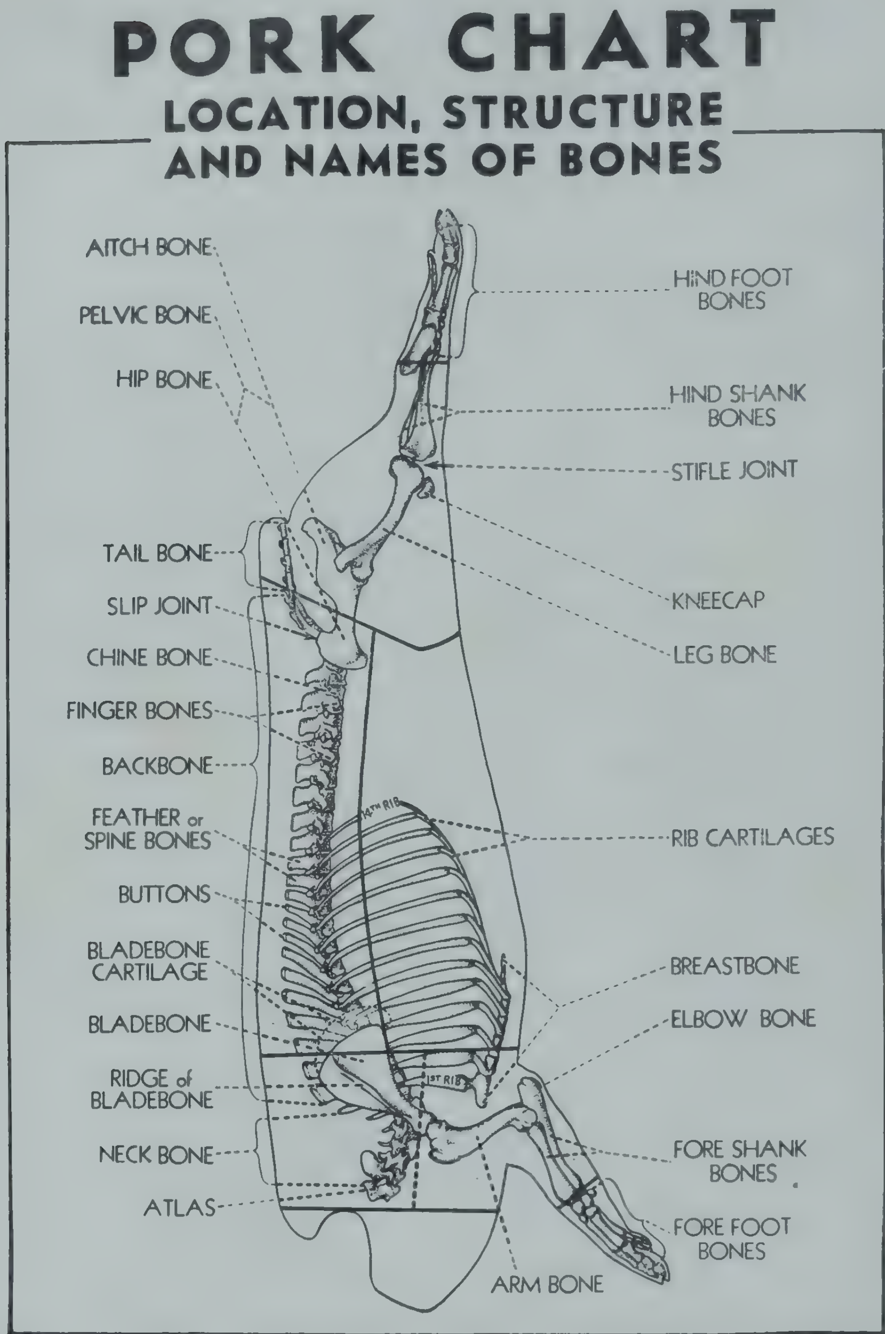


Fig. 68.—Pork chart, location, structure and name of bones. (National Live Stock and Meat Board.)

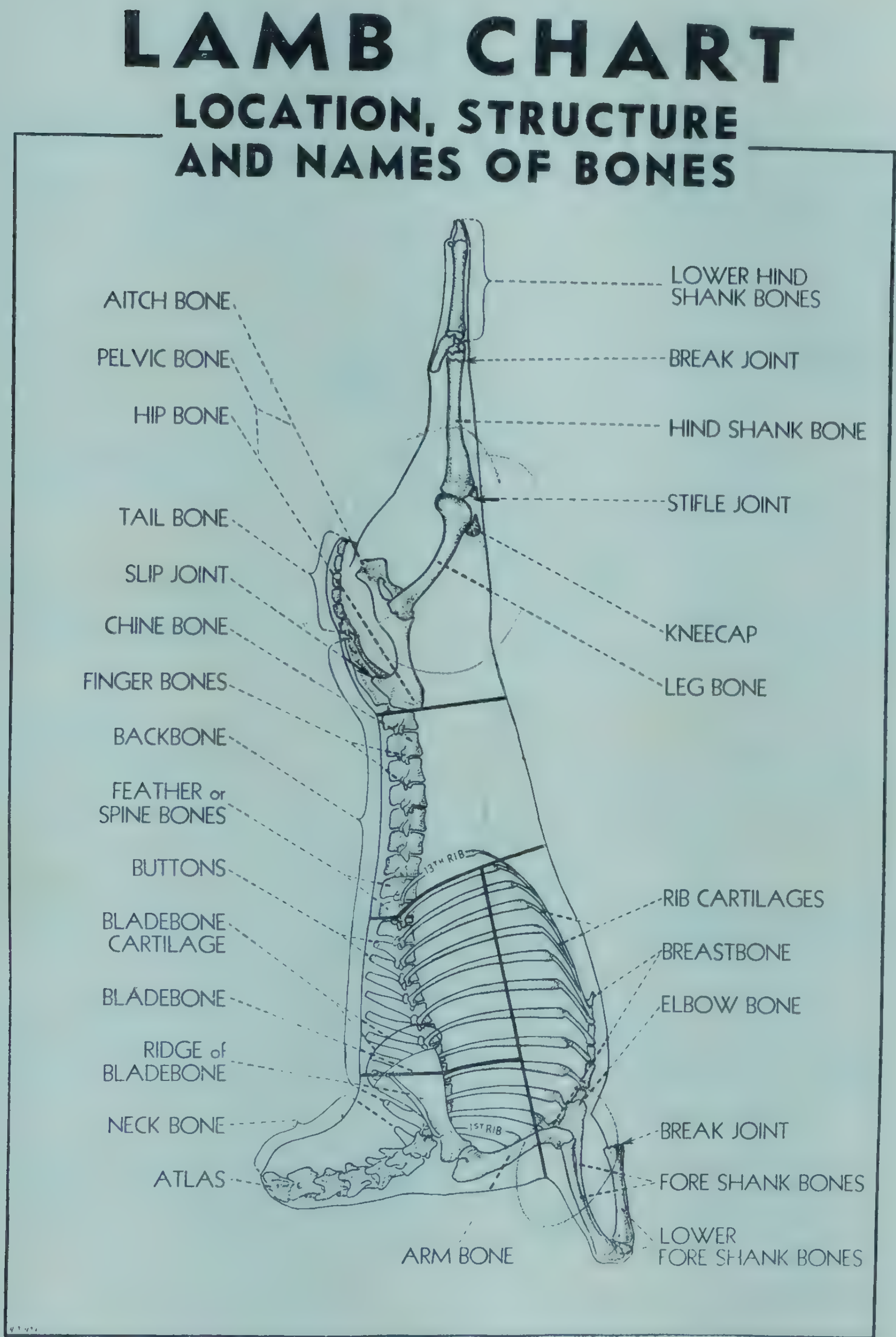


FIG. 69.—Lamb chart, location, structure and name of bones. (National Live Stock and Meat Board.)

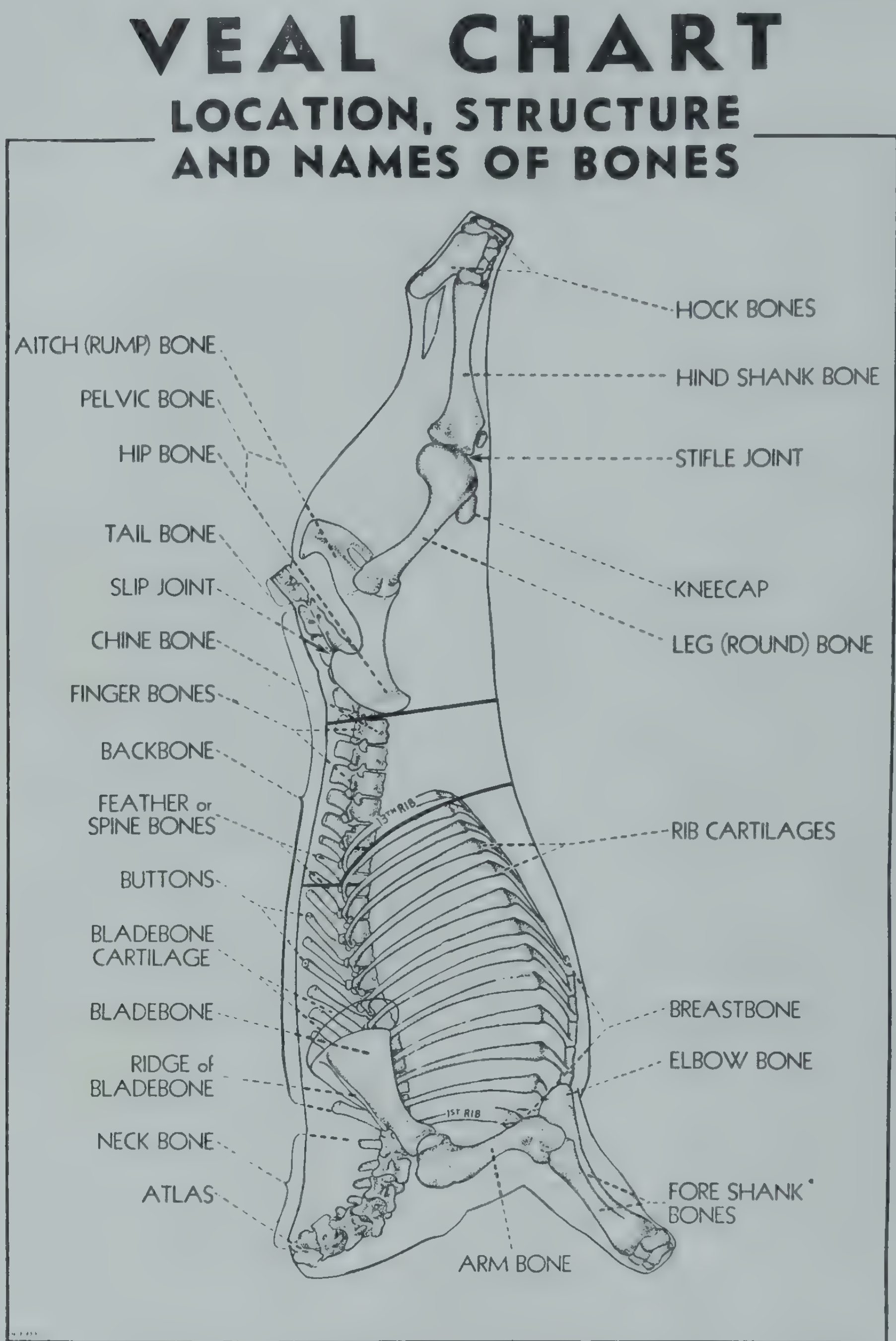


FIG. 70.—Veal chart, location, structure and name of bones. (National Live Stock and Meat Board.)

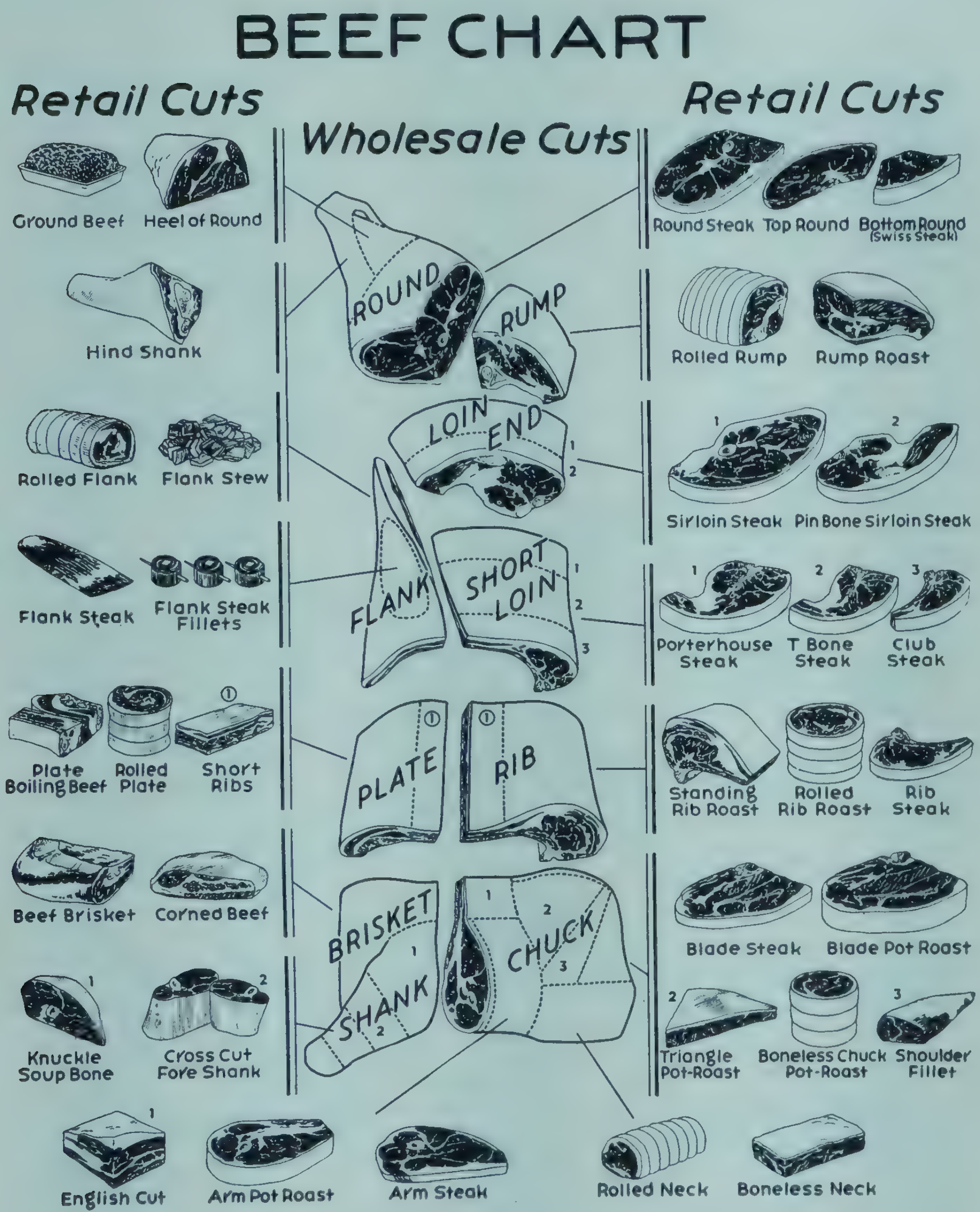


Fig. 71.—Beef chart, wholesale cuts. (National Live Stock and Meat Board.)

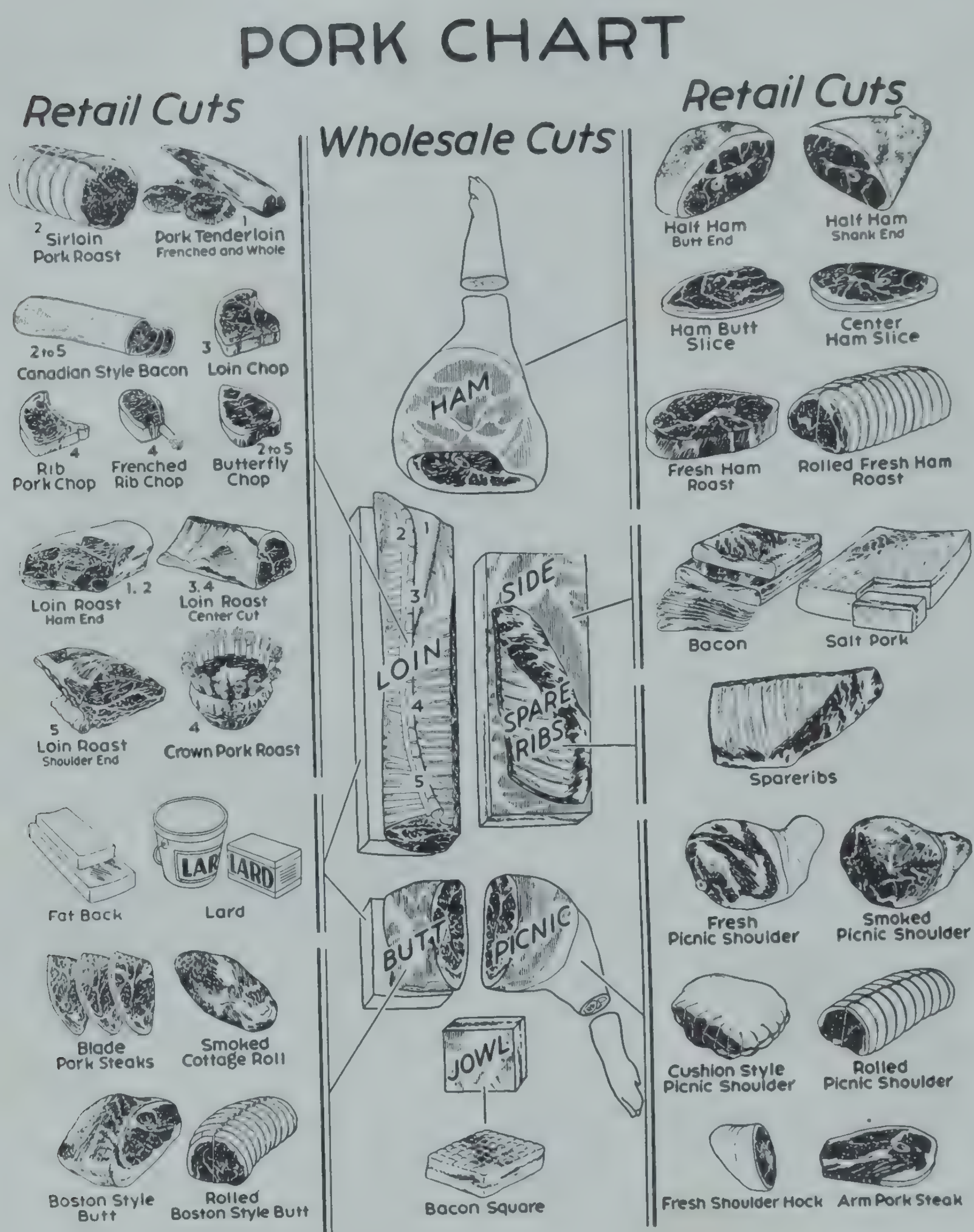


FIG. 72.—Pork chart, wholesale cuts. (National Live Stock and Meat Board.)

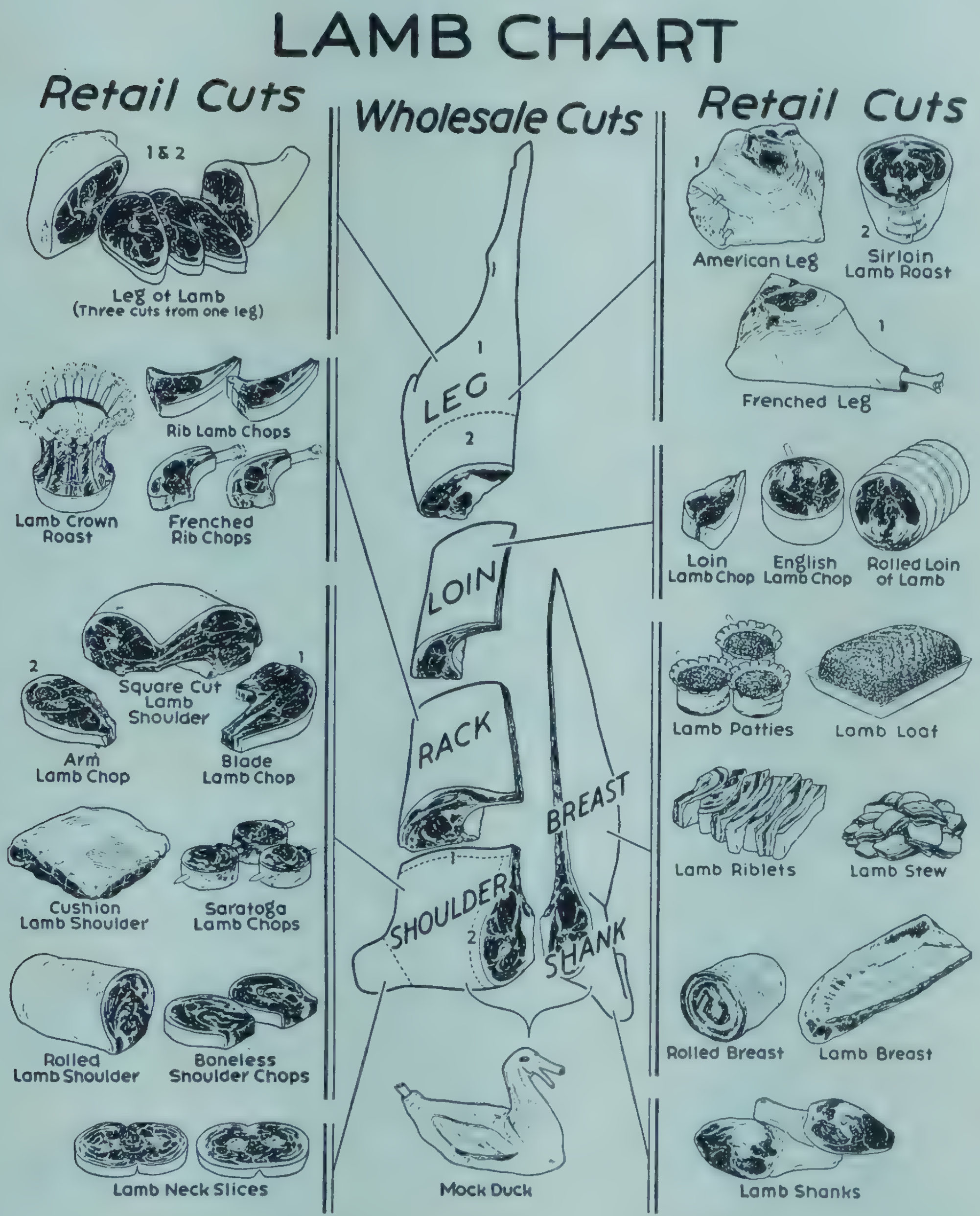


Fig. 73.—Lamb chart, wholesale cuts. (National Live Stock and Meat Board.)

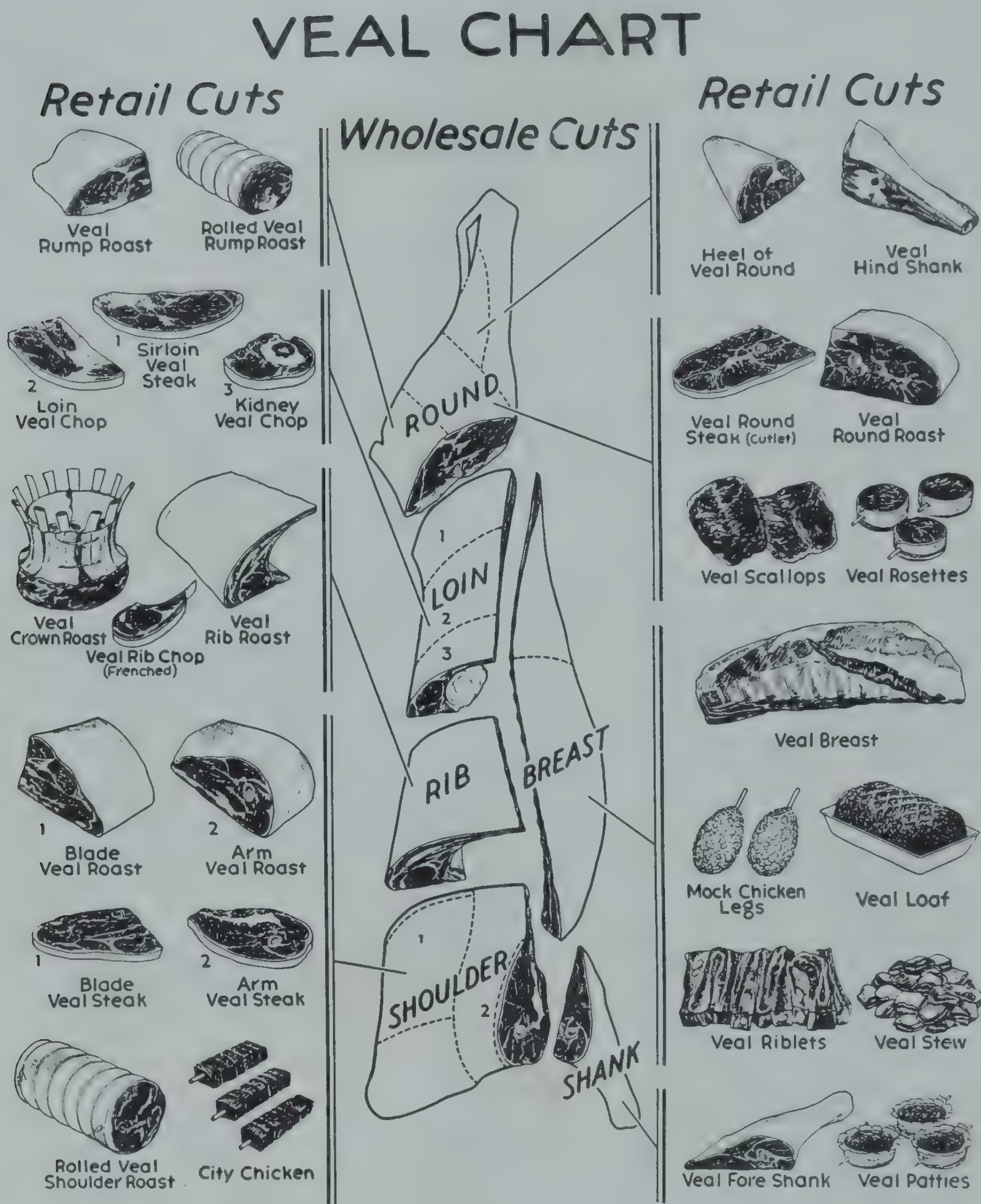


FIG. 74.—Veal chart, wholesale cuts. (National Live Stock and Meat Board.)

Meat that has been quick-frozen to a temperature of −15°F. by comparison with meat frozen to a temperature of 15°F. has a lighter and more desirable color in the frozen state. Also, the meat quick-frozen at the lower temperature tends to retain its juices better and is firmer after thawing. Some claims are made for an improved tenderness of the meat that is quick-frozen to a lower temperature.

The size and location of ice crystals in frozen meats depend on the rate at which the temperature of the meat is dropped from just above the freezing point to a temperature of about 25°F. Small intrafiber ice crystals form in the quickly frozen meats and large extrafiber ice crystals are characteristic of slowly frozen meats. In beef, aging before freezing is also a factor. Large extrafiber ice crystals form when aged beef is frozen. However, the aging of beef appears to improve the ability of the defrosted muscle tissue to reabsorb some of the "frozen out" water.

When meats are frozen at a temperature just below the freezing point the freezing progresses very slowly. Ice crystals $\frac{1}{2}$ inch long and $\frac{1}{8}$ inch thick have been observed in beef after several weeks at a temperature of 28°F. On the other hand beef steaks $\frac{1}{2}$ inch thick derived from freshly killed beef when frozen within a few minutes at a temperature of −30°F. showed very small intrafiber ice crystals.

The color of frozen meat is determined by the size and location of the ice crystals. Color differences in frozen meat, therefore, disappear when the meat is thawed. Beef steaks quick-frozen at very low temperatures have been observed to possess a color lighter than the fresh meat. Steaks slow-frozen at 20°F. were observed to be darker than the fresh meat. Steaks quick-frozen at −20°F. possess a color comparable to the fresh steaks.

Defrosting.—Large quantities of fresh pork cuts, such as hams, picnics, pork butts, and pork loins, are placed in the freezer each year during the season when there is a heavy run of hogs. These are to be taken out later for distribution to the trade or for processing into cured and smoked products when the hog runs are comparatively light. Large quantities of frozen pork cuts are defrosted as they are removed from the freezer. Progress in defrosting in recent years has resulted in methods of handling which avoid deterioration of the product as its temperature is elevated. Frozen meat is no longer placed on racks in a warm atmosphere since defrosting under these conditions tends to elevate the temperature of the surface of the meat to the point that favors spoilage before the interior of the meat is adequately defrosted. The practice now widely employed involves the use of vats in which the frozen meat is defrosted in circulating water at temperatures up to 90°F. By carefully controlling the temperature of the water and its circulation throughout the tank in which frozen meat cuts are placed for defrosting, the temperature of the meats can be raised to desired temperatures promptly when they are removed from the defrosting equipment before deterioration sets in.

Aging.—Pork, veal, lamb, and mutton that are intended to be sold to the consumer in a fresh, chilled condition pass through the meat packing plant as quickly as their chilling and preparation for the trade can be accomplished. Certain classes of beef, on the other hand, are frequently held for relatively long periods of time for the purpose of effecting changes

in tenderness and flavor which are desired by some consumers. This holding is done under controlled conditions of temperature and humidity and it is the process called aging of beef. It is generally conceded that meat contains enzymes capable of digesting it, and this process of digestion is usually referred to as autolysis. This aging of beef might be considered as being accomplished by the process of controlled autolysis.

Satisfactory results are obtained in aging beef when temperature and humidity are rigidly controlled. The optimum temperature has been found to be 36°F., and a relative humidity of 85 to 87 per cent is generally used. The frequency of air change is about 7 times per hour. Beef aged under these conditions will present a minimum of deterioration through dehydration and discoloration of the surface tissues. Beef is aged from three to six weeks under these conditions depending on the tastes of the consumer.

During the holding period care is exercised to avoid any variation in temperature which would cause the beef to become moist and sticky. For example, the meat is protected from drafts of warm air such as might enter through open doors.

There are three different conditions that affect the beef during the process of aging. First, the enzymatic action which, if properly controlled, accomplishes the purposes of normal aging. Second, micro-organisms on or in the meat multiply and attack the tissues. The growth of the micro-organisms is held in check by the rigid temperature controls. Third, oxidation changes occur that result from exposure of the surface of the meat to the atmosphere. These changes are usually too slow to be noticeable in the holding periods commonly employed.

In recent years a method of handling beef has been developed that accelerates the so-called aging process. This method is based on the principle that as the temperature of the medium rises above freezing, marked acceleration of the enzymatic action occurs. The method also employes a controlled enzymatic action, using exact temperatures and exposure time.

The dressed carcasses of beef intended to be subjected to the accelerated aging process are chilled promptly as they leave the slaughtering department. However, instead of being chilled to temperatures just above freezing, the temperature of the beef is not permitted to drop below 54° F. The optimum temperature is one that ranges from 54° to 59°F. throughout the beef. This beef is then placed in an atmosphere with a temperature of 68°F. A relative humidity ranging from 80 to 85 per cent is maintained in the air surrounding the carcass and its velocity is from 50 to 75 feet per minute. Under these conditions the internal meat temperature increases 0.50° to 0.75°F. per hour and reaches 66°F. after eighteen to twenty-two hours. The beef is removed from the quick aging room after it has been held forty-four hours, with an absolute maximum of forty-eight hours. It is then re-chilled promptly to reduce its temperature to just above freezing within not longer than twenty-four hours.

An additional precaution is employed in the quick aging process of beef having for its purpose the control of the growth of micro-organisms on the surface of the beef while it is exposed to the 68°F. temperature. It is inevitable that spoilage organisms will be present on the surface of the beef and

they will grow rapidly under the conditions of exposure in the quick aging room. To check this growth, all surfaces of the beef are exposed to ultraviolet irradiation produced by lamps that provide an effective bactericidal radiation.

Curing.—The salting of meats was done primarily to preserve them. Long before the development of the meat packing industry, meats were treated with salt solutions or packed in salt to keep them from spoiling so that they might be held for use at a later date. It was the common practice to salt meat produced during cold weather to hold it over for use in the warmer seasons. This salting of meat continued as an important practice with the development of trade, since it enabled the meat to be shipped from an area of production to an area of consumption without deterioration.

The consumer has developed a taste for salted meat and the modern meat curing practices of the meat packing industry are aimed more at supplying the consumer with a product to satisfy his taste than a meat that has been salted for its preservation. The materials commonly used in the curing of meats are salt, sugar, sodium nitrate, potassium nitrate, sodium nitrite, and, sometimes, spices.

Sweet Pickle Cure.—There are two general types of sweet pickle cure: long cure and short or fast cure. The short cure usually employs the process of pumping the pickle into the arterial system of the meat cut or injecting the pickle deep into the meat cut at many points.

A solution of salt is the basis of all pickle and the first step consists of making up a 100° salometer strength solution of salt and then diluting it to whatever strength of pickle may be desired for the cure. Usually a 70° pickle is used in the sweet pickle cure. To this is added the sugar and nitrate and/or nitrite which are dissolved previously in water in a separate container in order to insure complete solution of these ingredients in the pickle. The temperature of the finished pickle is brought down to 36°F. Before bringing the temperature of the pickle to 36°F., some packers heat the pumping pickle to 180°F. for twenty minutes in order to destroy any bacteria which might have contaminated the ingredients.

It is customary to use one formula for the pickle which is to be injected or pumped into the body or the arterial system of the meat cut and another formula for the pickle in which the meat cut is submerged or covered. Following are formulas commonly used in the sweet pickle curing of meats:

Typical Nitrate Cure for Hams

	Pump Pickle	*Cover Pickle*
Sodium nitrate per 100 gals.	8 lbs.	4 lbs.
Sugar (wh. gran.) " " "	20 lbs.	10 lbs.
Salometer—finished pickle	90°	75°

Typical Nitrite Cure for Hams

Nitrite of Soda per 100 gals.	24 oz.	16 oz.
Sugar (wh. gran.) " " "	20 lbs.	10 lbs.
Salometer—finished pickle	90°	75°

Typical Mixed Cure

Nitrite of Soda per 100 gals.	$1\frac{1}{2}$ lbs.	1 lb.
Sodium nitrate " " "	1 lb.	2 lbs.
Sugar " " "	20 lbs.	10 lbs.
Salometer—finished pickle	90°	70°

The inside temperature of meat intended to be cured should not exceed 38°F. Furthermore, temperatures much lower than 38°F. greatly retard the cure.

Whether the meat cut is to be long or short cured the first process to which it is subjected is the injection of curing solution into the body of the product. There are a few packers who do not inject pickle into meat cuts that are intended to be given the long cure. Injecting the pickle into the meat speeds up the cure and since it hastens the penetration of the salt throughout the article, it reduces the incidence of deteriorative changes in the center of the product.

The pickle is injected into long cure hams at various points. For this type of cure the amount of pickle injected at each point varies from 2 to 4 ozs., with 3 ozs. being the average.

For example, in a ham to be long cured the pickle is injected at five different points. An injection is made into the shank between the shank and the pin bone, or fibula. An injection is made just posterior to the femoro-tibial joint. Another injection is made under the pelvic bone through the obturator foramen or what is also called the hole in the aitch bone. An injection is inserted about 4½ inches in the flank side parallel with the femur, and another into the cushion of the ham from the butt end below and on the cushion side of the projection of the pelvic bone through the butt end of the ham.

Since meats are pumped to speed up the cure and minimize deteriorative changes in the meat prior to the salt penetration, the injections of pickle are inserted into those parts most subject to deterioration and those parts to which the cure penetrates most slowly from the outside.

For the rapid curing of pork hams and pork shoulder cuts, as well as cuts of beef, they are artery or spray pumped. For the artery pumping a special needle is used which is inserted into the exposed end of the artery and a definite amount of pickle usually amounting to 8 to 10 per cent of the total weight of the meat cut is forced into the arterial system. In hams, two injections are made, one into the branch of the artery leading to the cushion of the ham and the other into the branch leading to the flank.

For spray pumping, the needle has a number of holes through which the pickle passes into the meat. The number of insertions made with this needle is much greater than when pickle is pumped into hams for a long cure.

Spray pumping requires greater care in its application than does artery pumping to obtain a uniform distribution of the cure in the meat. In the case of artery pumping, the pumper must watch for ruptured blood vessels. When there is a ruptured blood vessel the meat does not swell characteristically as the pickle is injected into it.

After the meat has been pumped, it is then placed in cure. It is packed carefully in the curing container and it is then covered with pickle. At least 4½ to 5½ gallons of pickle are used for each 100 pounds of meat. When meats are to be given the long cure they are repacked 3 times. This repacking is called overhauling and consists of transferring the meats to another vat and then pouring over them the original curing pickle. The

first overhaul is done five days after the meat is first put into the pickle. The second overhauling is ten days later, and the third overhauling is fifteen days after the second. A cured ham, for example is left in cure about three and one-half days for each pound of its weight.

Practice regarding the length of cure for short cured artery pumped hams, for example, varies widely. Generally, these hams are not held for more than fifteen days combining the curing and draining period and, in some cases, it is a much shorter period.

It is sometimes necessary to store cured meats for a short period after curing and before smoking. They are packed loosely and held at 36° to 38°F. if the storage period is not more than fifteen days, and at 26° to 28°F. up to thirty days.

Plain Pickle Cure.—A plain salt pickle is used that contains no sugar and, in some cases, no nitrates or nitrites. Bean pork is commonly cured in plain salt pickle containing no sugar, nitrates, or nitrites, however, sodium nitrate is sometimes used. Approximately 190 pounds of the pork is placed in a barrel after first covering the bottom of the barrel with about 20 pounds of coarse salt. After the pork is placed in the barrel another 20 pounds of coarse salt is spread over the top of the pork. This coarse salt is called capping salt and gets its name from this pactice of using it to cover or cap-off the meat after it is packed in the barrel. After the bean pork is packed in the barrel with the capping salt, the barrel is filled with 100° brine. Usually 5 to $5\frac{1}{2}$ gallons of 100° brine is used to each 100 pounds of meat. When bean pork is packed in a barrel in this manner for curing, a common practice is to enclose the pork in a muslin sack which separates it from the coarse salt at both ends of the barrel.

Barreled fat backs for export are commonly cured with plain 100° salt pickle that contains no sugar, nitrate, or nitrite. Generally, the fat backs are first placed in vats and covered with the 100° brine. As the fat backs are placed in the vat fine salt is sprinkled on them between each layer. The fat backs are overhauled at the end of five days and again after another five days. When they are ready for shipment the fat backs are placed in barrels with 20 pounds of coarse salt covering the bottom of each barrel. Approximately 290 pounds of fat backs are placed in each barrel and 20 pounds of capping salt is placed on top of the fat backs. The barrel is then filled with 100° brine and closed for shipment.

Spareribs are commonly cured in plain pickle to which nitrate is added. Two hundred and sixty pounds of meat are packed in a tierce with a mixture of salt and nitrate in the proportion of 10 pounds of fine salt to 12 ounces of saltpeter sprinkled over the spareribs as they are packed in layers. The tierce full of spareribs is then filled with 100° brine. The tierce is then covered tightly and after six days it is rolled vigorously to effect an overhauling of its contents.

Dry Cure.—*Fancy dry cure.*—This is the method usually used in the curing of bacon. The pork bellies are rubbed on all sides with the dry cure mixture and placed in boxes with the curing resulting from the moisture in the meat dissolving the curing ingredients which then penetrate into the interior of the bellies.

Following are typical formulas for dry curing.

Nitrate Cure

3 lbs. fine granulated salt
$2\frac{1}{4}$ lbs. granulated cane sugar
4 ozs. sodium nitrate

Nitrite Cure

3 lbs. salt
$2\frac{1}{4}$ lbs. sugar
0.5 to 0.75 ozs. nitrite of soda

Mixed Cure

3 lbs. salt
$2\frac{1}{4}$ lbs. cane sugar
$\frac{1}{4}$ oz. nitrite of soda
2 ozs. sodium nitrate

Five pounds of the mixture are used for every 100 pounds of bellies.

The ingredients of the particular dry curing formula are mixed with a high degree of care to assure their uniform dispersal throughout the mixture. This is particularly important with respect to the nitrite ingredient.

The pork bellies are packed in tight boxes made of galvanized iron or stainless steel. Frequently the boxes are lined with heavy waxed paper. Before packing the bellies in the curing box its bottom is covered with a light sprinkle of the curing mixture. Each cut is rubbed thoroughly with the curing mixture and placed in the box meat side up. The bellies are packed in tightly and each layer is sprinkled with the curing mixture. The amount of curing mixture is weighed out separately for each box and the experienced operator will so gauge his packing that there will be an equal distribution of the mixture throughout the box and at the same time just enough left to cover the top layer. The top layer is placed skin side up. An effort is made to so pack each box as to leave no empty spaces since otherwise the pickle formed by the meat juices may not be sufficient to cover the meat. Any large space left in the box after packing due to uneven sizes of bellies may be filled in with briskets or jowls. After the box has been packed the lid is clamped down tightly so that the pickle resulting from a solution of the curing ingredients in the meat juices will cover the meat. The bellies are not removed from the box until the end of the curing period which is generally three days for each pound weight of the average belly in the container.

Semi-Dry Cure.—This method is also used in curing pork bellies in the preparation of bacon. It differs from the dry cure method in that 40° pickle is used to cover the bellies after they are packed in the box. On account of the added pickle the salt in the dry cure formula is cut down $\frac{1}{2}$ pound for each 100 pounds of meat to be cured.

Dry Cured Hams.—With the exception of Italian style ham, dry curing of hams is no longer generally conducted by the meat packer in the United States. The dry curing mixture is rubbed over the surface of each ham and they are piled closely together skin side down in layers with a layer of the dry curing mixture between each layer of hams. This stack of hams

is then covered with heavy paper to protect the meat from circulation of air. The hams are overhauled after five days, fifteen days, and thirty days and are re-rubbed with the curing mixture at each overhauling. The total time in cure ranges from forty days to sixty-five days depending on the weight of the hams. The pelvic bone is removed from the Italian style ham before it is cured. This enables the ham to be pressed flat to a thickness of about 2 inches.

Dry Salt Cure.—This method of cure results in a high salt content in the finished cured product and was commonly employed in curing many classes of meat cuts for export. It is still used quite widely for pork fat backs and also occasionally for pork jowls and heavy pork bellies.

Fat backs are commonly stacked 3 to $3\frac{1}{2}$ feet high using 7 to 8 per cent salt. The first overhauling is made after eight to ten days in cure when the fat backs are restacked as high as 4 feet. Approximately 5 per cent of salt is used when the fat backs are restacked at the first overhauling. For the heavier fat backs there is a second overhauling at the end of the twentieth day. The total curing time required for fat backs ranges from twenty to thirty days depending on their size. Dry salt fat backs frequently develop a pinkish color if held in cure over fifty-five days.

Before pork jowls are put down in salt they are soaked in 100° plain pickle for three to five days. After draining they are thoroughly salted and piled in stacks to complete the cure. Usually 6 to 7 pounds of salt are used to each 100 pounds of pork jowls. The jowls do not require overhauling and they cure in fifteen days.

Pork bellies to be dry salt cured are usually pumped with 100° pickle containing 10 pounds of saltpeter per 100 gallons of pickle. After being pumped they are salted thoroughly with 6 to 7 per cent of salt and piled in stacks. They are overhauled and pumped again after eight to ten days in cure. The usual curing period requires one day for each pound weight of each belly. It is not unusual for bellies to be soaked in pickle for a few days before being packed in dry salt.

Attention is given to the product exposed along the sides of the pack during the dry salt curing process to make sure that the exposed product is well salted.

Curing Ingredients.—Although any good commercial grade of salt is satisfactory for curing meats, the physical condition of the salt is of considerable importance. A salt that dissolves readily is desirable in the preparation of pickle solutions since, usually, the pickle is prepared by percolation without agitation. Flake salt is preferred for dry cure mixtures because it lends itself to uniform distribution of the curing materials in the mixture and a more uniform application to the meat. Rock salt commonly contains impurities such as shale which is not soluble in water. This is also true of other classes of salt and for this reason recrystallized salt is considered to be best for curing purposes when it comes directly in contact with the meat. Recrystallized salt is the salt prepared by dissolving in water the salt as it is removed from the mine or salt beds, settling and filtering out the impurities, and crystallizing the salt out of the solution by evaporation.

Flavor in cured meats is a factor of greater importance in recent years than the preservation of meats by curing. This is particularly true in meats

prepared by the sweet pickling method of curing and in bacon prepared by the fancy dry cure method. The use of salt in these curing processes, therefore, is adjusted to obtaining a particular flavor in the cured product rather than using it in concentrations that would accomplish a stablizing effect against deterioration of the cured product. Refrigeration is therefore still relied on to protect these classes of cured meats. Sugar as well as salt contribute to the flavor. The salt, of course, is the predominant flavor. The flavor contributed by the sugar in the curing formula is two-fold. It furnishes a favorable medium for the growth of flavor-producing bacteria as well as its normal sweetening effect. Although nitrate and nitrite are used primarily to fix the color of the cured meat, a characteristic flavor results from the action of the nitrite on the muscle tissue.

The curing process changes the chemical nature of meat pigment. This accounts for the difference in appearance between cured meats and fresh meats, particularly the retention by cured meats of a bright red color when they are cooked. It was once thought that the pigment of meat was identical with blood pigment and that the bright red color of cured meat resulted from the color fixation of blood pigment. Actually, the slaughter of animals includes a process of bleeding that removes most of the blood from the carcasses. Determinations of amount of muscle hemoglobin or myohemoglobin by Schenk, Hall, and King (1934), and by Watson (1935), occurring in the muscle tissue obtained from the carcasses of several animals indicate that this pigment comprises nearly all of the tissue pigment. The pigments of cured meats, therefore, are nitric oxide myohemoglobin, and nitric oxide myohemochromogen. The nitric oxide or, more properly, nitrous acid, since the pH of meat is normally on the acid side, is derived from nitrite. The nitrite is either added to the meat as such as part of the curing mixture or is derived from the nitrate which is reduced through mycrobial action. The nitric oxide myohemoglobin is the first pigment produced in the cured meat and this is converted by heat into nitric oxide myohemochromogen, a denatured protein.

On page 385 of the appendix is a reprint of Section 18.7(k) of the Federal meat inspection regulations in which is prescribed the limitation for nitrate and nitrite used as curing ingredients for meat prepared under Federal meat inspection.

Smoking.—Like curing meat with salt, the practice of subjecting meat to wood smoke goes back to pre-historic times. Modern practices of smoking meats differ from ancient practices principally in that formerly considerable drying out of the meat during the smoking process was accomplished. This drying out of the smoked meat contributed to its keeping qualities, however, the bactericidal action of the products of the wood smoke that are deposited on the meat inhibits the development of spoilage organisms and the antioxidant effect of some of these wood smoke products retards the development of rancidity in the fat. Like curing, the smoking of meats imparts a taste to the product for which the consumer has developed a decided preference. Modern smoking methods which are conducted under controlled conditions of temperature and humidity accomplish an optimum smoke flavor in the product with a minimum of drying out of the product, gaining at the same time the bactericidal and antioxidant effects of the

products of the wood smoke which are deposited on the meat and fat.

The old method of firing the smokehouse is the obvious one of building a fire of hardwood in the pit of the smokehouse. This produced the heat and smoke to which the meats hung in the smokehouse were subjected. Frequently, the fire was smudged with sawdust to increase the volume of smoke. Sometimes several fires would be built in an effort to distribute the heat and smoke uniformly throughout the smokehouse. In recognition of the need for uniform distribution of heat throughout the smokehouse and a more controlled volume of smoke, heating devices are installed in smokehouses and the smudging of the sawdust is regulated. Charcoal burners and steam coils are examples of devices that are installed in smokehouses to provide a uniform and regulated heat. Sawdust is smudged by means of controlled currents of air or by applying gas or oil flames to the sawdust. Where oil is used care is exercised to produce a flame with perfect combustion so as to avoid oily soot which may be deposited on the meat. Smoke generators located outside of the smokehouse have also come into use. These lend themselves to effective control and the smoke is carried in ducts from the generator to the smokehouse where the meat is hung.

Hickory sawdust is preferred by most packers for smoking meats. As a practical matter sawdust derived exclusively from any particular wood is not generally available commercially with the result that sawdust from a variety of hardwoods is usually used. In addition to hickory, sawdust derived from oak, maple, birch and beech is used with good results—with that derived from the seasoned wood being preferred. Walnut is said to give a quick color to meats but the flavor that its smoke imparts to meats is considered by some to be undesirable. The soft woods are avoided since their smoke also imparts an unpleasant taste to the meat.

In work done by Pettet and Lane in 1940 on the chemical composition of woodsmoke, they extracted with methylene dichloride the condensates of woodsmoke and found them to consist of formaldehyde, acetaldehyde, furfuraldehyde, 5-methyl furfuraldehyde, acetone, diacetyl, methyl and ethyl alcohols, phenol, formic and acetic acids, resins, and wax. All woodsmokes appear to contain less of the aldehydes, phenols, and aliphatic acids than the product of destructive distillation of wood. The preservative action of woodsmoke on meat is considered to be due to the condensates consisting of aldehydes, phenols, and aliphatic acids.

The Canadian workers, White, Gibbons, Woodcock and Cook, in 1942 made bacteriological, chemical, and physical examinations on smoked and unsmoked Wiltshire bacon. They observed that smoking reduced the number of surface bacteria approximately 10 to 4 times the number present before smoking and effectively retarded growth during storage. They also found smoked bacon to be more resistant to rancidity than unsmoked bacon. This confirms Lee's observations in 1939 that smoke enables surface fat of bacon to resist oxidation for considerable periods of time.

Meats that have been subjected to the long curing process are smoked at lower temperatures than the quickly cured artery or spray-pumped meats. The cured meats that are to be smoked at lower temperatures are first permitted to dry either in a hanging room provided for the purpose or during the initial period in the smokehouse. After they have dried, the

meats in the smokehouse are subjected to rapidly rising temperatures which reach 135°F. This temperature is maintained in the smokehouse until the interior temperature of the meat has reached at least 110°F. The characteristic color of smoked meats is more permanently set and heightened if the meat is smoked to a degree that raises the internal temperature to approximately 118°F.

After the period of smoking at a high temperature, known as the "hot smoke", the temperature of the smokehouse is lowered to approximately 120°F., where it is held throughout the remainder of the smoking operation. During this period, the smokehouse ventilators are closed or nearly closed in order to produce a thick and heavy smoke cloud throughout the smokehouse.

Care is exercised to see that the internal temperature of the pork products smoked according to the foregoing description of processing does not rise to the point where the meat acquires a cooked appearance which may occur at around 120°F. The further heating of such pork to reach an internal temperature of at least 137°F. is necessary for the destruction of possible live trichinæ since pork having a cooked appearance may be eaten without further cooking.

The artery- or spray-pumped cured meats are subjected to a process of heating in the smokehouse for the production of "tendered" and ready-to-eat smoked meats. This process consists of subjecting the meats to relatively high temperatures for extended periods of time which accomplishes tenderness in the product and raises the temperature of the pork above the 137°F. necessary for the destruction of possible live trichinæ. The usual practice is to reach an internal temperature of about 140°F. for the "tendered" product which is intended to be further cooked by the consumer before serving. The ready-to-eat smoked meats are heated to internal temperatures ranging from 150°F. to as high as 165°F.

The "tendered" and ready-to-eat smoked meats are more perishable than other types of smoked meats and are handled the same as a cooked product. They are transferred directly from the smokehouse into a refrigerated hanging room, held at a temperature close to 40°F. These products are chilled promptly so that the meat will pass quickly through the critical temperature range from 75°F. to 105°F. The mild cure of this class of product will not protect it against spoilage under favorable conditions of bacterial growth.

Smoking imparts a desirable appearance to the surface of the meat through a combination of actions. Through its drying out effect and the action by the aldehyde-phenol condensed resins on the film of grease that develops on the dried out surface, there is accomplished the gloss which is the characteristic appearance of the surface of smoked meats.

During the smoking process the reduction of nitrate to nitrite is inhibited and the amount of nitrite in the meat at the beginning of the smoking operation is reduced sharply during the heating of the meat in the smokehouse. The disappearance of the nitrite is explained as occurring because of the reaction between the nitrite and the aliphatic amino group of the protein. High temperature is the factor responsible for the destruction of nitrite in the meat during the smoking process. Jensen is of the opinion

that in addition to the reaction on the nitrite by the amino groups of the protein, oxidation of the nitrous acid, especially on the surface area of the meat, accounts for part of the reduction of the nitrite content during the smoking of the meat.

There is no change in the nitrate content of the meat during the smoking process and when present in the meat it carries over to produce more nitrite by the usual process of reduction following the cooling of the meat after it is smoked.

Although the products of smoke that are deposited on the meat have a strong bactericidal action, they do not have a comparable inhibitive effect on mold growth. The residual aldehydes from smoke are not especially effective as mycostats according to Jensen (1945). Furthermore, the curing agents are not particularly effective against mold growth. Mold, therefore, grows readily on smoked meats when the conditions for its growth are favorable. For this reason it is important to maintain the surface of smoked meats as dry as possible. Smoked meats are handled in such a way as to avoid the condensation of moisture on their surface and they are not exposed to humid atmospheric conditions.

Sausage Room Products.—**1. Sausage.**—The practice of stuffing salted chopped meat flavored with spices in animal casings is an ancient custom. It can be visualized as developing logically in connection with the economic utilization of all the edible portions of the carcasses of food animals. There are records of sausage being a popular item of food during the Grecian and Roman eras, and independently of the European practices, the American Indian is known to have prepared a rudimentary sausage consisting of chopped dried meat mixed with dried berries and pressed into a cake.

By the Middle Ages, sausage making was extensively practiced on a commercial scale in many localities throughout Europe. Out of these practices developed types of sausage characteristic of certain localities. For example, Frankfurt-on-Main in Germany developed the popular frankfurter, bologna is said to have originated in Bologna, Italy, genoa salami in Genoa, Italy, berliner in Berlin, Germany, braunschweiger in Brunswick, Germany, gottborg in Gothenberg, Sweden, wieners in Vienna, Austria, etc. Dry sausages as a class were developed in the warm sections of Italy and Southern France. In the colder climate of Northern Europe the fresh, semi-dry, and smoked and cooked varieties of sausage were developed. Although types of dry sausage were produced in the colder climates of Europe and fresh sausage was actually used in the warmer climates, classes of sausage products as developed in various areas were influenced by climatic conditions since artificial refrigeration was unknown.

With the exception of bulk fresh sausage which sometimes is not merchandised in casings, sausage products are universally prepared in casings. Originally, these casings were of animal origin but in recent years so-called artificial casings made from hydro-cellulose and plastic materials have become very popular.

Animal Casings.—ROUNDS.—The term "round" refers to the animal casing derived from the small intestines of cattle, calves, sheep, and hogs. The small intestines of sheep and hogs are separated from their mesenteric attachments by pulling which frees them entirely from the fat and tissue

at their attachments. The small intestines of cattle and calves are severed from their mesenteric attachments by a process of cutting called "running." This leaves attached to the severed intestine some fat and tissue derived from its mesenteric attachment. In any case, the intestine is stripped clean of its contents and the superficial fat adhering to the intestines of cattle and calves is also removed. The cleaned intestines are chilled, drained, and salted. The cattle rounds are graded according to their diameter as narrow, medium, and wide. The narrow grades are usually $1\frac{3}{8}$ of an inch or less in diameter, the medium grades are $1\frac{3}{8}$ of an inch to $1\frac{1}{2}$ of an inch in diameter, and the wide grades over $1\frac{1}{2}$ of an inch in diameter. The sheep rounds are classified in five grades according to their diameter: narrow, narrow medium, special medium, wide, and extra wide. The narrow grade ranges from 16 to 18 mm. in diameter, the narrow medium 18 to 20 mm., special medium 20 to 22 mm., wide 22 to 24 mm., and extra wide 24 to 26 mm. Hog rounds are usually placed in three grades: narrow, medium, and wide. The narrow grade measures up to $1\frac{1}{8}$ of an inch in diameter, medium measures $1\frac{1}{8}$ of an inch to $1\frac{3}{8}$ of an inch in diameter, and the wide over $1\frac{3}{8}$ of an inch in diameter.

MIDDLES.—These are derived from the large intestines of cattle and hogs. They are removed from their mesenteric attachment by a combination of cutting and pulling which leaves some of the mesenteric fat attached to the severed intestine. The intestines are thoroughly flushed free of their contents and the excess fat is removed. The fat is removed from the intestines of cattle by first chipping it off manually using knives or scissors, after which the intestines are passed through fatting machines. After being fatted the intestines are turned inside out and sent through a sliming machine which thoroughly cleans their mucous surface. The cleaned intestines are then chilled in cold water and later drained and salted. The hog middles usually measure approximately 7 feet in length and varies considerably in diameter. The cattle middles, or, as they are usually designated, the beef middles are packed in sets measuring not less than 57 feet consisting of 5 pieces to the set and they are classed as "wide" running 2 inches and over in diameter and "narrow" under 2 inches.

BUNGS.—The bung derived from cattle is called the beef bung and is made from the cecum. This casing is sometimes called the "blind gut." It is handled substantially the same as the beef middle. The beef bung ranges from 18 to 36 inches in length which is determined by the location of the ileocecal valve.

The hog bung is the terminal end of the intestinal tract of hogs, the desirable length being at least 5 feet. After it is separated from the rest of the viscera, the bung gut is stripped of its contents and trimmed of its excess fat. The anal end of the hog bung is called the "crown." After the fat is trimmed the bung is inflated with air, measured for width, and inspected for grade. The width is measured by inserting the inflated bung into a gauge at a point 18 to 20 inches from the crown. The better grades of bungs are full crowned, free from cuts and stains, and the larger sizes are preferred. After being graded, the hog bungs are turned inside out and are chilled in cold water before being salted.

SEWED CASINGS.—Beef middles and small hog bungs are used for making sewed casings of a uniform diameter. The middles and bungs are stretched on flat wooden forms and are hung up to dry in a circulation of air. After these casings have sufficiently dried they are cut along a groove in one edge of the wooden form. The pieces are then flattened out and sewed together to make a casing with one end closed and of a uniform diameter.

BLADDERS.—The urinary bladders of hogs and cattle are used in preparing this class of animal casing. They are cleaned thoroughly after which they are either packed in salt or inflated with air and dried. After being thoroughly dried they are then softened in an atmosphere of steam in the drying room. In this softened condition they are removed from the drying room and flattened out for tying in bundles, after which they are packed in boxes for shipment or taken directly to the sausage department.

WEASANDS.—The cattle esophagus from which the weasand is manufactured consists of two portions—the muscular coat and the mucosa. These are easily separated from each other. The muscular coat is edible muscle tissue which is commonly used in sausage manufacture. The mucosa is made into the casing known as the weasand. The mucosa is first inspected for the larval form of the hypoderma lineata and all infested portions are removed and discarded. The parasite-free mucosa is inflated with air, tied off at both ends and hung up to dry. After drying, one end of the weasand is cut off at the point where it is tied and the weasand is ready for shipment from the plant or for use as a casing in sausage manufacture.

HOG STOMACHS.—When the hog stomach is intended for use as a container for sausage it is not slit wide open as is done when the stomach is prepared for use as an ingredient of a meat food product. It is saved intact and flushed of its contents. It is then turned inside out and the mucous surface is thoroughly cleaned. After being cleaned the stomach is chilled and salted. The stomachs are first placed in salt in a perforated container which permits drainage of the liquids produced by the action of the salt on the stomachs. The following day the stomachs are re-packed in salt where they are left until thoroughly cured.

Artificial Casings.—Since about 1920, casings of hydrocellulose material have been made in sizes and shapes resembling animal casings. This class of casings is sometimes referred to as "artificial casings" by contrast with the term "natural" casings for the casings of animal origin. The artificial casings are both transparent and translucent. They are permeable and compare quite favorably in strength with the animal variety. The hydrocellulose material used in the preparation of artificial casings tends to become brittle and for this reason it is impregnated with hydroscopic softening agents. The casings are moistened at the time they are used as containers for sausage products since this gives them pliability and facilitates their handling. This wetting, however, tends to dissolve out the hydroscopic softening agent. Therefore, only those casings which are to be used promptly are moistened because casings that are permitted to dry out tend to become brittle.

Classes of Sausage.—FRESH.—This class of sausage derives its name from the fact that the sausages are neither cured, smoked, nor cooked.

Only enough water is used in their preparation to facilitate chopping of the ingredients and is limited to 3 per cent of the total of the ingredients used.

Pork Sausage.—As the name implies, this sausage is prepared with chopped pork and flavoring. Many flavoring combinations are used but those that include sage, pepper, and mace are the most popular. White pepper is preferred to black pepper because the latter tends to darken the product. Pork sausage is generally stuffed in sheep or hog rounds but it is also distributed in bulk sometimes packaged in transparent wrappings in 1-pound units. When stuffed in sheep and hog rounds of the narrower sizes, the sausage is usually linked but when it is stuffed in wide hog rounds it is not linked.

Breakfast Sausage.—This is made from a variety of meat and meat by-product ingredients usually with pork predominating. Dried skim milk or cereal is sometimes used as an ingredient of this class of fresh sausage and in an amount not to exceed a total of 3½ per cent in the finished product. Breakfast sausage is prepared in bulk and in sheep and hog rounds similar to pork sausage.

Fresh Thuringer.—This is an all-meat sausage made predominantly of pork to which veal is added. The meat is flavored with a combination of spices, such as mace, ground caraway, ginger, pepper, ground celery seed, and coriander in addition to sugar and salt. It is stuffed in wide hog rounds and usually linked, with 3 to 5 links to the pound.

COOKED SAUSAGE.—This class of sausage is characterized by the quality imparted to the product through the addition of nitrates and/or nitrites and also through the processes of smoking and cooking. This sausage is cooked either in vats of water, steam chambers, or in the smokehouse.

The meat and meat by-product ingredients intended for use in the preparation of this class of sausage were at one time thoroughly cured prior to their use as ingredients. A method has been developed whereby the nitrite or nitrate and nitrite is mixed intimately with the meat and meat by-product ingredients at the time they are chopped preparatory to stuffing in the casings. This method is sometimes referred to as "emulsion" cure. It derives its name from the practice of finely chopping the meat while at the same time adding a solution of the nitrite or nitrate and nitrite. This mixture is referred to as an emulsified mass. The nitrite acts immediately on the pigment of the finely chopped meat and meat by-products with which it is intimately associated. This mixture is sometimes allowed to stand at a temperature of 38°F. for twenty-four hours before it is mixed with the flavoring ingredients. Variations of this method have been developed and, in some cases, the flavoring materials are chopped in with the meat and meat by-product along with the nitrite or nitrate and nitrite and the mixture is stuffed immediately into the casings. Sometimes the stuffed product is permitted to hang for several hours before it is placed in the smokehouse.

When the coarse-chopped varieties of cooked sausage are prepared, the mixture of chopped meat and the nitrite or nitrate and nitrite is held at a temperature of 38°F. for such time as is necessary to permit the nitrite to act on the meat pigment. This may take from one to four days depending on the degree of coarseness to which the meat ingredient is chopped.

It is essential that the conversion of the myohemoglobin of the meat by the nitrite to nitroso myohemoglobin be complete before the sausage is submitted to the smoking or heating processes. The nitroso myohemoglobin formed by the action of the nitrite on the pigment of the meat and meat by-products is converted into nitroso myohemochromogen during the smoking and cooking. To facilitate chopping and blending of the ingredients and to impart a juiciness to the finished article, water is a substantial ingredient of cooked sausage. However, its use is limited to that amount which will result in the finished product containing not more than 10 per cent added water.

When the casing is to be colored as part of the processing of the sausage product, the coloring material is usually added to the water in the tank in which the sausage is cooked.

Finely Chopped Sausage.—A. Frankfurters and Wieners.—These names are used in different parts of the country to identify the same product. They are prepared with a wide variety of meat and meat by-product ingredients. Also, dried skim milk, cereal, or soya flour is used in an amount which individually or collectively does not exceed a total of $3\frac{1}{2}$ per cent in the finished product. A formula consisting of three parts of bull meat or beef chucks to two parts of pork trimmings is considered to produce the best quality product. A great variety of flavoring materials is used, however, a combination of white pepper, coriander, and nutmeg or mace is probably the most popular.

The ingredients are stuffed in sheep or hog rounds or in hydrocellulose casings of comparable size. The length of the links varies between different sections of the country. The stuffed product is placed in a smokehouse in which the temperature is usually raised to 160°F. By this method the frankfurters are heated thoroughly at the same time that they are smoked. They reach an internal temperature well over the 137°F. which is required to destroy possible live trichina in the pork muscle tissue. This makes them safe for eating without further cooking. In some cases the cooking of the frankfurter is completed in a vat of water ranging in temperature from 165° to 170°F. This cooking is usually limited to from seven to ten minutes.

B. Bologna.—This is prepared in "long", "large", and "round" varieties Long bologna is stuffed in beef middles approximately 18 inches long or in corresponding artificial casings. Large bologna is stuffed in beef bungs approximately 18 inches long. Round bologna is stuffed in beef rounds or the corresponding size of artificial casings, usually 16 inches long. The same mixture of ingredients that is used in the preparation of frankfurters and wieners is generally used in preparing bologna. The method of processing is also quite similar except that the bologna usually receives its thorough cooking in a vat of hot water following the smoking operation. Cooking of the bologna is conducted at such temperature and for a period of time sufficient to reach a temperature of 137°F. throughout the product. This is another class of sausage product that is customarily eaten without cooking and this temperature is necessary to destroy possible live trichinæ. Actually, an internal temperature of 150°F. is usually attained throughout the bologna at the time it is cooked.

C. Knackwurst.—This class of sausage is made from the same ingredient combinations as are used in the preparation of frankfurters, wieners, and bologna, except that there is no dried skim milk, cereal, or soya flour added. The product is characterized by its large size and short links, being stuffed in a beef round and tied off in 4-inch links. It is usually flavored with garlic which also is a distinguishing characteristic.

D. Liver Sausage.—This sausage is distinctive in flavor and appearance by contrast with other classes of sausage due to the color and texture imparted to it by its liver content. A mixture of liver and pork, or liver, pork, and veal is popular for this class of sausage. In any case, liver constitutes at least 30 per cent of the total ingredients. Although liver sausage is usually smoked prior to cooking, some packers make an unsmoked variety. A good grade of smoked liver sausage is sometimes called braunschweiger.

There are many ingredient combinations used in the preparation of liver sausage. However, pork liver usually makes up the liver content which, as stated above, is used in an amount equal to not less than 30 per cent of the total ingredients. Sometimes nitrite or nitrate and nitrite are added to the ingredients. The blending and chopping of the ingredients result in a smooth homogenous mass which is stuffed directly into the casing. The stuffed product is then cooked or smoked and cooked depending on the local practice. The cooking is usually quite thorough with an internal temperature of approximately 165°F. reached throughout the article.

Coarse-cut.—A. Polish.—The beef ingredient is chopped through a $\frac{1}{8}$ inch plate and the pork ingredient is chopped through a $\frac{1}{2}$ inch plate. The meat is then mixed thoroughly with the flavoring materials, and nitrite or nitrate and nitrite, and the water. The mixture is stuffed in medium or wide hog rounds and tied off in links at least 6 inches long.

Since the mixture consists of coarsely chopped meat, the stuffed product is held from twelve to twenty-four hours to permit the nitrite to penetrate into the meat particles and act on the meat pigment before the sausage is placed in the smokehouse. During the smoking the temperature of the smokehouse is raised to over 160°F. which thoroughly heats the product, raising its temperature to the point where it is safe to eat without further cooking. The sausage receives no additional cooking to the heating it receives in the smokehouse. It is showered with cold water as it is removed from the smokehouse.

B. Smoked Pork Sausage (Country Style).—As the name implies, this sausage is made entirely of pork with no added ingredients except the flavorings, and nitrite or nitrate and nitrite, and water. In the southern States, smoked pork sausage is sometimes made without nitrate or nitrite. The pork is ground through a $\frac{1}{4}$ inch plate and then mixed with the other ingredients. The mixture is stuffed in a medium hog round and held for twelve hours to permit the nitrite to act on the meat before it is placed in the smokehouse. Since this sausage is classed as one that is customarily eaten without cooking, it is required to reach an internal temperature of at least 137°F. Usually this temperature is attained during the smoking operation.

C. Berliner or New England.—This is a characteristic, coarse-cut sausage stuffed in large casings. It is made predominantly of pork with a small

percentage of beef. The meat is ground through a $\frac{3}{4}$ inch plate after which it is mixed with salt, sugar, and nitrite or nitrate and nitrite, and water. Because of the large pieces of meat, the mixture is held at a temperature of 38°F. for three or four days to permit the nitrite to penetrate the pieces of meat and act on its pigment. After this curing period, the mixture is stuffed in large artificial casings or in beef bungs or beef bladders. The product is then smoked at a temperature ranging from 120° to 145°F. after which it is cooked for four to six hours in water at a temperature of 160°F. A temperature of around 148°F. is attained throughout the product.

D. Minced Bologna.—This a coarsely chopped bologna stuffed in beef bungs or artificial casings of similar size. Usually pork predominates and the flavoring materials are similar to those used in the preparation of the finely cut varieties of bologna. The ingredients are mixed and the mixture is held for three to four days to permit the nitrite to penetrate the coarsely cut particles of meat before the mixture is stuffed in the casing and placed in the smokehouse. After being smoked for several hours at temperatures ranging from 120° to 145°F. the sausage is removed from the smokehouse and cooked in water from four to six hours at a temperaturue of 160°F. A temperature close to 150°F. is attained throughout the product during the cooking operation.

E. Salami Cotto (*Cooked Salami*).—By contrast with most salami this is subjected to relatively high temperatures in the smokehouse, which produces a cooked product. It is prepared predominantly of pork with beef added. The pork is ground through a $\frac{1}{2}$ inch plate and the beef through a $\frac{1}{8}$ inch plate. The ground meat is mixed with salt, sugar, black pepper and nitrite or nitrate and nitrite. The mixture is held at 38°F. for at least forty-eight hours to permit the nitrite to act on the meat pigment before the mixture is stuffed in the casing. After stuffing, the product is usually held for another twenty-four hours at 38°F. and then it is placed in the smokehouse. The heating of the salami in the smokehouse is conducted without smoke. The temperature of the salami is raised above 137°F. to make it safe for eating without further cooking.

F. Thuringer.—This is a cooked, smoked, coarsely chopped sausage prepared predominantly of beef to which pork is added. It is stuffed in a wide hog round. To the coarsely ground meat are added sugar, ground white pepper, whole white pepper, mustard, salt, and nitrite or nitrate and nitrite. The chopped mixture is held at 38°F. for forth-eight hours to permit the nitrite to act on the meat pigment. It is then stuffed into the wide hog round and placed in the smokehouse where it is subjected to smoke at relatively low temperatures and finished with a hot smoke during which the internal temperature of the sausage is raised above 137°F.

METTWURST.—This sausage is sometimes called "smearwurst" and is characterized by its soft spreading consistency. In this respect it differs from all other classes of sausage. It is made predominantly of pork which is chopped fine with the salt, flavoring materials, and nitrite or nitrate and nitrite. The ingredients are stuffed into a wide hog round or beef round and tied off in links 2 to 3 inches long. It is smoked at comparatively low temperatures. Since this class of sausage is customarily eaten by spreading it on bread by the consumer without any further preparation, it is necessary

that the pork ingredient be treated by one of the methods to destroy possible live trichinæ. The processing of the sausage does not usually accomplish this because the smokehouse temperature is not high enough to raise the temperature of the sausage over 137°F. So-called certified pork is therefore used as an ingredient. Suck pork is identified as having been treated to destroy possible live trichinæ and this is usually done by freezing. Viable trichinæ are destroyed in pork that is frozen for twenty days at 5°F., ten days at −10°F., or six days at −20°F.

SEMI-DRY. (SOFT) (SUMMER).—The semi-dry sausages have gained increasing popularity in the United States by contrast with the dry variety. It is difficult to place certain kinds of sausages categorically in either of the two classes. Some cervelats may be either semi-dry or dry, depending on the degree of drying preferred by the trade. It has become a practice, however, to prepare most cervelats as semi-dry sausages. In addition to consumer preference for a semi-dry cervelat, another consideration is the treatment required for those containing pork to destroy possible live trichinæ. It has been found convenient to attain a temperature over 137°F. in the smokehouse to accomplish this result rather than rely on the prolonged exacting drying treatment for this purpose.

Cervelats. Farmer and Holsteiner.—A combination of beef and pork is used in preparing these sausages, with beef predominating. The beef is chopped separately to a medium fine texture while the pork is cut into pieces about ½ inch in thickness. The meat is then mixed thoroughly with salt, spices, and nitrite or nitrate and nitrite. This mixture is stuffed in beef middles of a medium width for the manufacture of the farmer variety while for the holsteiner variety it is stuffed in wide beef rounds. Before being stuffed in the casings, the mixture is held for from two to three days to permit the nitrite to act on the meat. After stuffing, the sausage is allowed to hang for about twelve hours before smoking. It is given a heavy smoke. The temperature is raised in the smokehouse toward the end of the smoking period to attain an internal temperature of at least 137°F. throughout the product. After smoking, the sausage is allowed to hang in a dry room until the desired consistency is attained.

Thuringer.—Beef also predominates in the beef and pork mixture and this mixture is chopped to a moderate degree of fineness through a ⅛ inch plate. It is mixed with salt, spices, and nitrite or nitrate and nitrite after which it is held at 38°F. to permit the nitrite to act on the meat. The mixture is then stuffed in hog bungs or sewed hog bungs. It is left to hang in a drying room for from one to two days at a temperature of 55°F. after which it is given a two-day smoke at relatively low temperatures, the temperature gradually rising to 110°F. This treatment produces a tangy flavor in the thuringer and to facilitate this a harmless bacterial starter of the acidophilus type is sometimes added to the ingredients. Since the processing of this sausage would not destroy possible live trichinæ, the pork ingredient is certified to its having been previously treated to make it safe against trichinæ.

Mortadella.—Pork predominates as an ingredient in this class of sausage and it is mixed with beef and, sometimes, veal. A distinguishing characteristic is the presence of cubed pork fat distributed throughout the meat

mixture. The pork and beef are ground to a medium degree of fineness and this is mixed with salt, spices, and nitrite or nitrate and nitrite. This mixture is held at 38°F. for one or two days to permit the nitrite to act on the meat after which it is mixed with the cubed pork fat and stuffed into small or medium-size beef bladders. The product is then usually held in a cooler for twenty-four hours after which it is transferred to a smokehouse that is equipped for heating to approximately 160°F. Mortadella is held at relatively low temperatures in the smokehouse for the first four hours and then the temperature is raised gradually to about 120°F. at the end of the first twelve hours. During the next twelve to eighteen hours the temperature in the smokehouse is raised to approximately 160°F. and held until an internal temperature of 140°F. is attained throughout the product.

Lebanon.—This is an all-beef sausage. The beef is ground to a medium degree of fineness and mixed with salt, sugar, spices, and nitrite or nitrate and nitrite. Sometimes the beef is thoroughly cured before it is chopped and mixed with the other ingredients. The mixture is stuffed in a beef bung and smoked in a well-ventilated smokehouse for from five days to two weeks in a wet, cold smoke. Weather conditions vary the smoking time. A harmless bacterial starter of the acidophilus type may be included in the ingredients for the purpose of controlled flavor development. The finished product is characterized by a tangy flavor traceable to the growth of this type of organism during the processing of the product.

DRY (HARD DRY).—This class of sausage is hung to dry for periods ranging from one month to six months. Mechanically controlled drying rooms are provided so that the conditions surrounding the product while it is hanging in the drying room will not be affected by outside weather conditions. The effectiveness of this control is related directly to the success of the drying process and if properly performed will hold to a minimum the formation of mold on the outside of the sausage. One objective is to so maintain the surface of the casing that moisture from the interior of the sausage will be extracted gradually and constantly. If this drying out process progresses properly, no hollow spots will develop in the product and it will set up as a firm, compact mass. This is significant, particularly in that if spaces develop inside the product interior mold may form and ruin the product. The confining of moisture within the product not only favors the development of interior mold but also produces souring and spoilage. Temperatures maintained in sausage drying rooms range from 52° to 56°F. and the relative humidity from 65% to 80% depending on the character of the product. The system is designed so that the conditioned air is distributed uniformly throughout the drying room. Different grades of sausage require different rates of air circulation. For example, sausages in beef bungs need more draft for drying than sausages in beef rounds.

Most dry sausage contains pork as an ingredient, and it must therefore be treated by a method that will destroy possible live trichinæ. Since frozen pork is not considered desirable for the preparation of dry sausage and heating is not employed in the process, dry sausage is processed by a combination of curing and drying that will assure its safety for eating by the consumer without any further processing.

One of five methods is used. These methods are recognized as adequate

for the destruction of possible live trichinæ by the meat inspection service of the United States Department of Agriculture (page 389 of the Appendix).

Salamis.—Milano.—A mixture of pork and beef with pork predominating is used in preparing this class of dry sausage. The beef is ground to a fairly fine consistency while the pork is given a coarser grind. The pork and beef are then mixed along with salt, sugar, spices, and nitrite or nitrate and nitrite. The mixture is held at 38°F. for a day or two to give the nitrite an opportunity to act on the meat. The mixture is then stuffed in hog bungs. The stuffed product is hung in what is called the green room to permit the excess moisture to drip from the casing and evaporate from its surface. After this preliminary drying the salami is closely bound with Italian hemp. It is then hung in the drying room and not smoked.

Genoa.—This class of salami is quite similar to the milano type except that it is usually stuffed in sewed hog bungs and the piece is generally shorter than the milano type, being from 16 to 20 inches long while the milano may run from 18 to 30 inches in length.

B. C. Salami.—This salami is sometimes referred to as the German type and differs from the milano and genoa or Italian types in that the ingredients are stuffed in a beef middle and it is smoked before being placed in the drying room. Another distinguishing feature is that the loops of twine surrounding the sausage are spaced considerably wider than is the case with the Italian types. Also, it is generally shorter, ranging from 11 to 15 inches in length.

Pepperoni.—The pepper content of its spicing characterizes this sausage. The pork and beef ingredients are coarsely chopped and mixed with salt, sugar, spices, and the nitrite or nitrate and nitrite. The mixture is held for forty-eight hours at a temperature of 38°F. to permit the nitrite to act on the meat and then it is stuffed in hog rounds and twin-tied in pieces 10 to 12 inches long. It is then hung in the drying room for the period of time necessary to meet the requirements for the destruction of possible live trichinæ. This product is not smoked.

Frizzie.—It derives its name from the crinkled or irregular shape imparted to it by the hog middle in which it is stuffed. The finished article is from 10 to 12 inches long and approximately 3 inches in diameter, being wrapped closely with No. 9 Italian hemp. The pork and beef ingredients are chopped medium fine and mixed with the seasoning and nitrite or nitrate and nitrite after which it is held for one or two days at 38°F. to give the curing materials an opportunity to act on the meat ingredient. The stuffed product is placed in a drying room without smoking and is dried thoroughly for from sixty to ninety days or at least sufficiently to meet the requirement for the destruction of possible live trichinæ. Frizzies are also known as soppresata.

Chorizos.—This is a highly spiced Spanish type dry sausage generally made entirely of pork but sometimes containing a small percentage of beef. The meat is ground medium fine and mixed with salt, seasoning, and nitrite or nitrate and nitrite. The seasoning includes garlic, sweet red pepper, hot red pepper, chili powder, and, sometimes, white wine vinegar. The ingredients are stuffed into narrow or medium-wide hog rounds or wide sheep casings and linked in 3 or 4 inch lengths. It is then dried and

lightly smoked after which it is dried again. The curing and drying process meets the requirement for the destruction of possible live trichinæ.

Goteborg.—(*Sometimes referred to as Swedish sausage*).—This class of dry sausage is characterized by its sweet flavor derived from its principal spice, cardamon. It is made from a mixture of pork and beef combined with salt, seasoning, sugar, and nitrite or nitrate and nitrite. The meat is rather coarsely chopped and the ingredients are stuffed in a wide beef middle cut approximately 18 inches long. It is given a heavy smoke and then dried for at least that length of time necessary to meet the requirements for the destruction of possible live trichinæ.

2. Products Other Than Sausage That are Prepared in Casings. Sausage is the kind of food that lends itself easily to adulteration or imitation. It consists of a chopped up blend of ingredients in which an adulterant can easily be disguised. There is a constant temptation therefore to place on the market a product in a casing which resembles sausage but which in fact is not sausage because there is used in its preparation excessive amounts of substances, such as water, cereal, dried skim milk, soya flour, or ingredients that are foreign to sausage products, such as gelatin, tragacanth, or meats other than those derived from the carcasses of cattle, sheep, swine, or goats.

Products, such as bockwurst, liver pudding, pinkelwurst, kiska, headcheese, souse, lachschinken, and capocollo, are prepared in casings and do not meet the requirements for sausage but neither do they resemble sausage. On the other hand, products which resemble sausage and are prepared in casings are identified as imitation sausage.

Imitation Sausage.—The products that come in this class are usually made in imitation of frankfurters or bolognas. They bear a very close resemblance to sausage in appearance and taste but are usually prepared with amounts of water and cereal, dried skim milk, and soya flour considerably in excess of the limitations placed on the use of these ingredients in sausage.

Bockwurst.—The ingredients used in the preparation of this product are finely chopped and stuffed in wide sheep rounds. The links are about the same length as frankfurters. The meat ingredients usually consist of veal and pork, and in addition to spices, a common ingredient is milk which is used in substantial proportions. Finely chopped green onions and parsley are also usual ingredients. Bockwurst is distributed to the trade in a fresh condition without receiving any cooking or other processing in the packing plant.

Liver Pudding.—A mixture of pork liver and meat by-products to which is sometimes added soya flour. This mixture is chopped fine and stuffed in a beef round. The stuffed article is usually tied off in rings after which it is placed in a vat of hot water and thoroughly cooked. The consistency of the finished article is that of a pudding from which the article gets its name. Like other liver products the pork liver constitutes at least 30 per cent of the total of the ingredients used.

Pinkelwurst.—A mixture of beef fat, oat groats, water, onions, and spices is stuffed in a wide hog round. The finished product has the consistency of a dry pudding with the oat groats giving it a coarse texture. Its color

is white with a tinge of straw color. The stuffed article is thoroughly cooked before being shipped to the trade.

Kiska.—This article has the consistency of a heavy blood pudding and is made from pork, water, oat groats, pork liver, pork spleen, salt, beef blood, and spices, and stuffed in a beef round. It is thoroughly cooked before it is shipped from the meat packing plant. Sections of the oat groats are quite apparent on the cut surface of the product.

Headcheese.—This is a jellied product consisting predominantly of pork by-products, such as snouts, pork cheeks, and pork skins. It is seasoned with onions and a combination of spices usually consisting of thyme, ground cloves, ground celery seed, nutmeg and white pepper. The pork by-products are coarsely chopped, mixed with the other ingredients, and stuffed in hog bungs, hog stomachs, or artificial casings. It is cooked thoroughly at temperatures ranging from 170° to 175°F.

Souse.—(*Sulze*).—This product is prepared in the same manner as headcheese except that vinegar is an ingredient and imparts to it a characteristic mildly sour taste. Since the vinegar tends to hydrolize the gelatin in the product, the gelatin content of souse is fortified by the addition of commercial gelatin.

Lachschinken.—Two boneless cured pork loins are stuffed side by side in a medium beef middle and heated in the smokehouse in an atmosphere of smoke until a minimum temperature of 137°F. is attained throughout the pork muscle tissue. The pork loins are sometimes sprinkled with pepper and paprika before they are placed in the casing. In some cases the product is given a so-called cold smoke. When this method is used the pork loins have been certified to their having been treated by a process of freezing or curing that is recognized as being adequate for the destruction of possible live trichinæ.

Capocollo.—A cured pork butt is rubbed with a mixture of paprika and ground red pepper pods and stuffed into a beef bung. It is then smoked and air dried. Since capocollo is classed as a pork product customarily eaten without cooking the article is either heated in the smokehouse to a minimum temperature of 137°F. or the pork butts are certified to their having been treated either by freezing or curing with an approved method to destroy possible live trichinæ.

Jellied Tongue.—Cured, skinned pork, lamb, or sheep tongues are thoroughly cooked after which they are trimmed and rinsed thoroughly. They are then placed in a beef middle or artificial casing of comparable size and covered with a solution of 1 pound of gelatin in 5 to 7 pounds of warm water. The casing is stretched tightly over the tongues and tied off after which the product is cooled thoroughly and is then ready for the trade.

3. Other Products.—*Loaves.*—The most popular are those loaves made in oblong shape that make rectangular cross-section slices. A great many ingredient combinations are used and loaves fall roughly into two categories. Those identified as meat loaves make up one class and are subject to certain limitations concerning the ingredients used. The other class bears designations such as macaroni and cheese loaf, imitation chicken loaf, pimiento, pickle and cheese loaf, etc., in which a wide range of ingredients are used.

Loaves are frequently packaged in transparent hydrocellulose coverings or cellophane wrappers which are printed with the name of the product and the ingredient statement.

Meat Loaves.—These are prepared with various meat combinations along with cereal or dried skim milk added as a binder. A great variety of seasoning combinations are used; however, onions, pepper, and sage predominate. To facilitate chopping the meat and the blending of the ingredients a small amount of water is added which does not exceed 3 per cent of the total of the ingredients used.

A combination of pork and beef in the proportion of two to three parts of pork to one of beef is a popular meat formulation, as is a combination of veal and pork in approximately equal portions. A meat loaf consisting of pork and beef with cubes of American cheese distributed throughout is also a popular loaf and is given the designation "Meat and Cheese Loaf." Chopped corned beef is also processed in the form of a loaf.

Other Loaves.—Many kinds of vegetables, macaroni and cheese, pimiento and pickles, and a variety of meat by-products are blended with meat ingredients along with seasoning, binders such as cereal, dried skim milk and soya flour, and varying amounts of moisture to make a great variety of loaves. For example, a combination of beef, pork, macaroni, cheese, and cracker meal is prepared under the designation "Macaroni and Cheese Loaf." An article identified as "Imitation Chicken Loaf" is prepared from pork stomachs, beef tripe, veal, pork trimmings, flour, and pork stock. Another combination consisting of pimientos, pickles, cheese and pork is prepared under the designation "Pimiento, Pickle, and Cheese Loaf." Because these loaves are not represented as being meat loaves and are made of a great variety of ingredients, they are not held to the same requirements as to moisture and filler content as are meat loaves.

Hamburger.—This very popular meat product is prepared by chopping beef with or without the addition of beef fat to a medium coarse consistency. No moisture, seasoning, or flour of any kind is used. The amount of beef fat in the hamburger determines its quality but in no case does the fat, whether it is normal to the meat ingredient or added as such, exceed 30 per cent of the product.

Pork Roll.—Chopped pork is mixed with salt, nitrite or nitrate and nitrite, and flavoring usually consisting of pepper, and stuffed in a muslin container approximately 3 inches in diameter and from 18 to 24 inches in length. The stuffed article is then held for varying periods of time at temperatures which permit a tangy flavor to develop. Harmless bacterial starters of the acidophilus type are sometimes used as ingredients for the purpose of facilitating the development of the desired tangy flavor. The consistency and appearance of the pork roll on cross-section are such as to place it within the category of pork products customarily eaten without cooking and it is usually heated in the smokehouse to at least 137°F. throughout to destroy possible live trichinæ. Pork roll is not usually smoked. To facilitate blending of the ingredients water is sometimes added but in an amount not to exceed 3 per cent of the total of the ingredients used.

Cooked Pork Cuts.—Cooked ham, or as it is sometimes called, "boiled

ham" is the best known product in this category. Cured hams are boned and trimmed of their excess fat. The boned and fatted ham is pressed into a metal form and held in the form under pressure by a cover which is clamped to the form and pressed against the ham by the pressure of strong steel springs. The hams are then placed in large vats of water ranging in temperature from 165° to 185°F. They are cooked until they reach a minimum internal temperature ranging from 142° to 150°F. When the hams are removed from the cooking vat the tension of the lid is adjusted and the ham is allowed to cool before removing it from the mold. When the chilled ham is taken from the mold, it is washed in clear water to remove accumulations of gelatinous material and rendered fat left adhering to its surface, and it is then placed on racks in coolers exposed to a temperature of approximately 36°F. Uncured hams, cured pork shoulder picnics, pork loins, and pork shoulder butts are also sometimes cooked and they are handled very much the same in their preparation as are cooked hams.

Scrapple.—Pork and pork by-products usually make up the meat and meat by-product content of scrapple and total not less than 40 per cent of the ingredients used. The pork and pork by-products are cooked thoroughly and ground to a medium degree of fineness before being mixed with the other ingredients which usually consist of a mixture of cornmeal and corn flour, with pepper, sage, mace, nutmeg, and salt for seasoning. Sufficient water is added to bring the mixture to the desired consistency for further cooking. However, its amount is limited to that which will maintain the meat and meat by-product content at 40 per cent or higher. Sometimes rye flour or soya flour is used in addition to the cornmeal and corn flour.

Chili Con Carne.—This is usually distributed in 1-pound units as so-called bricks of chili con carne or in an artificial casing. The batch of ingredients which is thoroughly cooked contains at least 40 per cent meat and not more than 8 per cent individually or collectively of cereal or soya flour. There is no limit to the fat content which usually consists of beef fat and is present in substantial proportions to facilitate firming up of the finished product to a solid consistency. Chili con carne is usually a highly flavored combination of coarsely chopped meat in a spiced fatty gravy. The flavorings usually consist of salt, paprika, chili pepper, onions, garlic, ground cumin, oregano, coriander, and nutmeg.

Stews.—Beef stew and lamb stew are the ones most commonly prepared and they have respectively a beef and lamb content of not less than 25 per cent computed on the weight of the fresh meat. The meat, vegetables, water, seasoning, and flour are cooked thoroughly. The only significant variation in stews as they are prepared by various meat packers is the consistency of the gravy content. In some cases the cooked meat and vegetables are contained in a thick gravy while in others a thin gravy is used.

Canning.—By contrast with food preservation by curing with salt and by smoking and drying which go back to antiquity, canning is a recent development. Furthermore, while the modern processes of curing and smoking are less concerned with preservation than with accomplishing a particular flavor in the meat, the process of canning is entirely one of preservation.

A Frenchman, Nicholas Appert, through work done by him between 1795 and 1810, is given credit for the method of preservation of food by the application of heat to food in a sealed container. During 1795 when France was at war with several hostile European nations and in the throes of a domestic revolution, its military forces and civilian population suffered from an acute food shortage. The French Government, realizing that one of the solutions to this problem would be a method of food preservation that would permit more flexibility in handling food supplies, offered a prize of 12,000 francs to any person how would develop a new, successful means for preserving foods. Appert was awarded the prize in 1809 and he published the first treatise on canning in 1810.

The causes of food spoilage were not known at the time of Appert's works and he had no technical training or experience. The explanation offered by Appert himself was that he observed how heat applied to food sealed in a container which was impervious to air had the peculiar quality of preventing the food from spoiling. Although he did not know the reason why, his many experiments led him to the conclusion that cleanliness and sanitation in the handling of the food and its perparation were necessary and that the sealing of the container must make it airtight.

It is believed that William Underwood, who came to America in 1817, started the first American canning operations in Boston in 1819 using Appert's procedure. In 1820, both Underwood in Boston and Thomas Kensett in New York were engaged in the commercial production of canned foods.

The name "tin can" is considered to be an abbreviation of the English term "tin cannister." Actually, it is somewhat of a misnomer, since it is in fact made from tin plate which is a mild steel plate bearing a thin coat of pure tin amounting to about 1.5 per cent of the tin plate. Tin plate, can enamels, and sealing compounds are the materials used in can manufacture. The essential requirement of the tin plate is that it be corrosion resistant and strong enough to support and give rigidity to the particular class of container. The tin plate combines the corrosion resistant properties of tin and the physical strength of steel. The container must be strong enough to carry the product from the canner to the ultimate consumer and have the ability to withstand reasonable handling and shipping strains. All processed foods react on the inside of the container to some extent, however, in practice, this corrosion problem has usually been critical only for canned fruits. The successful use of tin plate in the food industry depends in part on such factors as the amount of tin coating the plate and its continuity, but to a greater degree on the efficiency with which the small, ever-present areas of exposed steel are protected. This is never fully effective and may vary from near protection to very little. For this reason, interest in tin plate from the corrosion viewpoint has also been centered on the steel and because of success here, commercial control of corrosion has been achieved.

Cans for processed foods are subjected to conditions of temperature and pressure that vary according to the severity of the heat processing that is required for producing commercial sterility. Meats may require steam pressure processing of ten to two hundred minutes duration at temperatures

of 235° to 260°F., depending on the consistency of the product in the can, the can size, and the pH of the product. During heating a differential pressure builds up within the can by comparison with the retort pressure as much as 20 pounds per square inch. The can ends must, therefore, resist

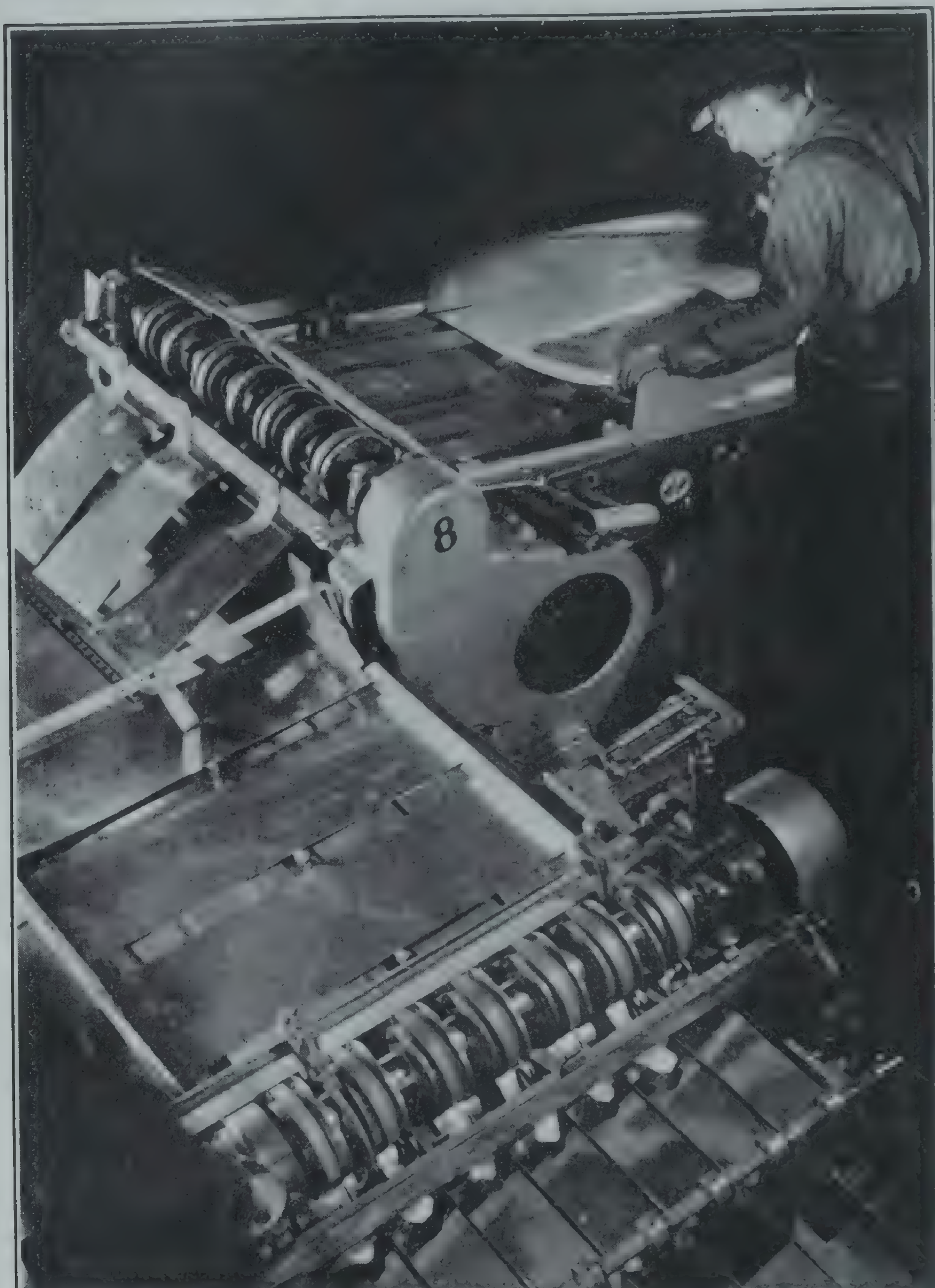


FIG. 75.—Slitter. (Furnished by American Can Co.)

permanent distortion at the countersink area as the retorts are opened and the cans are chilled. Also, some canned products are closed under mechanical vacuum preparatory to their heat processing resulting in a negative pressure of 15 to 20 inches at the time of closure subjecting the

can body to paneling or collapsing forces. The body of the can is designed to withstand these forces as well as subsequent strains during handling and shipping.

Before 1900, tin containers used commercially for foods were either of the now obsolete, hand-soldered, open top style, or of the more familiar "hole and cap style." In the center of the cap was a small hole or vent.

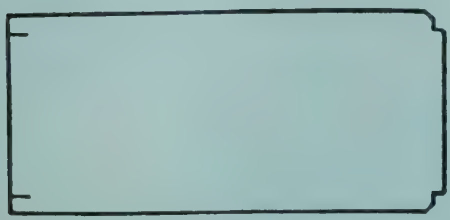


FIG. 76

FIG. 77

FIG. 78

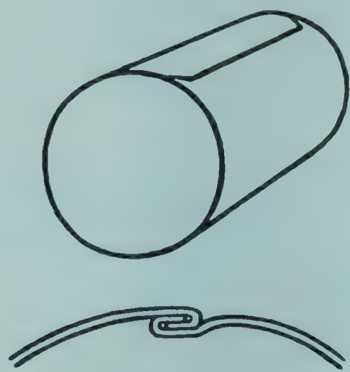


FIG. 79

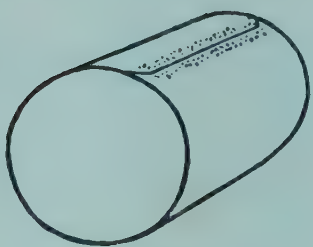


FIG. 80

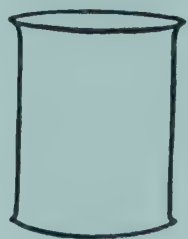


FIG. 81

FIGS. 76–81.—Fabrication of the sanitary can. (Furnished by American Can Co.)

The food was placed in the can and the cap sealed on by a special soldering iron. The vent hole was then closed or tipped with solder and the canned product was ready for heat processing.

A new style of can was introduced about 1900 known as the "sanitary" style.

The "Sanitary" Can.—Cans are made on a series of machines collectively known as a "can line." Sheets of tin plate are first fed by hand into a slitter (Fig. 75) which cuts them into "body blanks" from which the body is later formed. The body blanks are then fed into the bodymaker where a sequence of automatic operations is performed to complete the cylindrical body of the can.

The first station on the bodymaker notches the body blanks (Fig. 76). They are then hooked (Fig. 77) and the hooked blanks formed around the bodymaker (Fig. 78) and bumped to form the side seam of the can (Fig. 79).

The formed body then passes over fluxing wheels and then to the solder bath where revolving rolls apply solder to the outside of the side seam (Fig. 80). The soldered body next passes over a revolving solder wipe which removes excess solder from the outside of the can, after which it passes over a cooling section and is then led to the flanger, where the ends are curled outwardly by special pilots to form the so-called "flange" (Fig. 81).

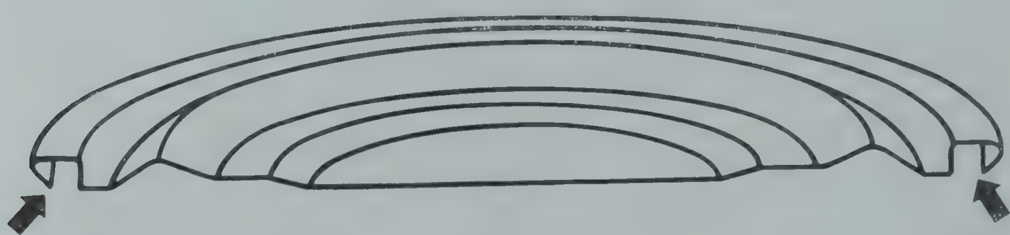


Fig. 82

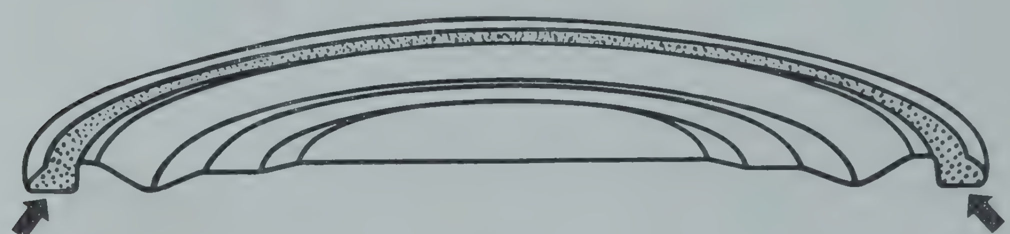


Fig. 83

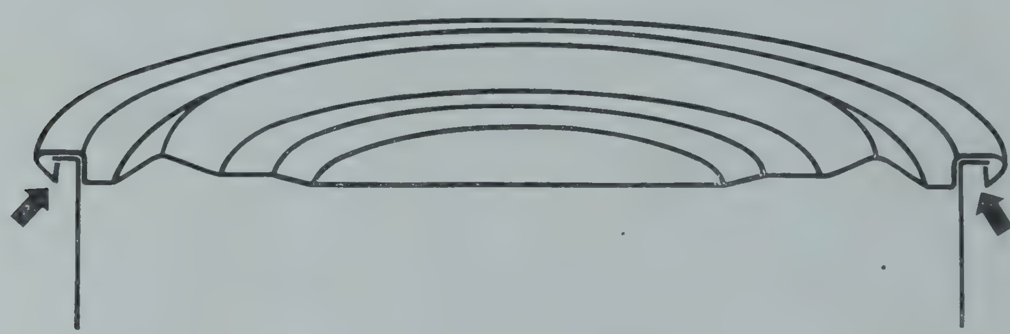


Fig. 84

Figs. 82–84.—Fabrication of the can end. (Furnished by American Can Co.)

At the same time that the can bodies are being fabricated, the ends are also being made by cutting the sheets of tin plate to the proper size with scroll shears and punching the ends out in a punch-press. The ends then pass through a machine which curls the edges inwardly (Fig. 82). Curled ends then go to the compound liner where a continuous ribbon of sealing "compound," a rubber gasket material, is extruded from a nozzle as a liquid and placed near the circumference within the curl (Fig. 83). Next a special machine dries the compound and the covers are complete. This

compound serves as a sealing medium between metal curl of cover and metal flange of can body. Relationship of parts are shown in figure 84.

After the flanged bodies leave the flanger, they proceed to the double-seamer where one end is applied. This operation is essentially the same as that used in the canning factory for sealing on the top of the can. After one end is sealed on, the cans go to a testing machine which, by means of air pressure, tests them for leaks, and automatically discards any that are faulty. After testing, the cans are loaded into shipping cartons or directly

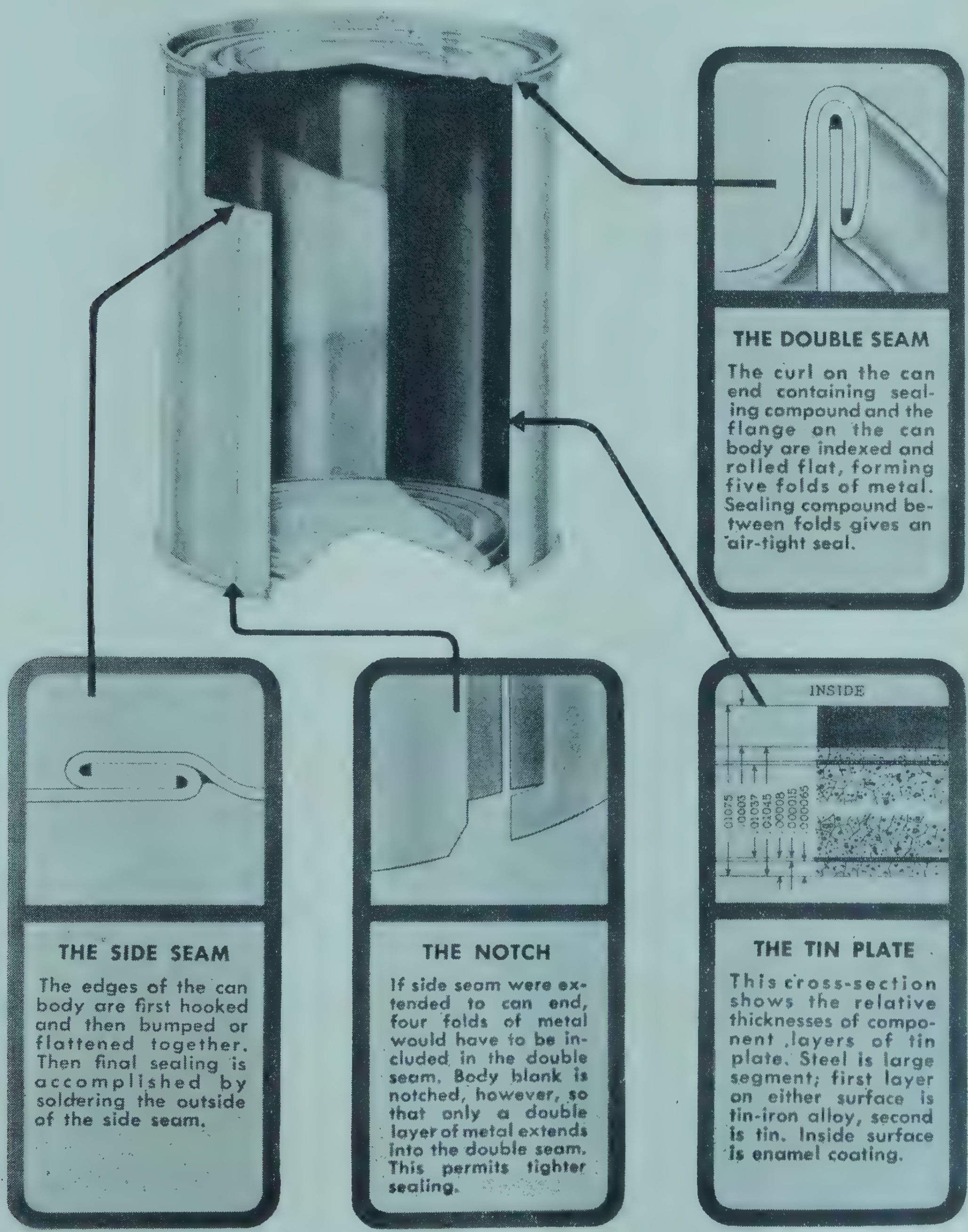


FIG. 85.—Architecture of the enameled sanitary tin can. (Furnished by American Can Co.)

into paper-lined box cars for shipment. The covers are packed separately in fiber tubes and shipped with the cans.

Enamel-lined cans are manufactured in the same manner as plain cans, except that the enamels are usually baked onto the sheets in gas-fired ovens before the bodies and ends are manufactured as described above.

Sealing Compounds.—An essential factor in the development of the open top "sanitary" can is the use of a suitable material for sealing the can end to the flanged body. The first sealing compound used was one consisting of a simple dispersion of rubber in benzol which, after being applied, was dusted with asbestos powder.

Synthetic rubber has been extensively substituted for natural rubber for some purposes, particularly where fat and oil solvent resistance is required. It is important that the sealing compound be resilient so that it will adjust itself to variations in seam tightness and fill, or crevices and irregularities of the double seam. This resilience must be retained over a temperature range from below room temperature to above 260°F.

The sealing compound must adhere to both tin plate and enameled tin plate, it must be impermeable to liquids and gases, it must not impart odor or taste to the product in the can, also it must not be affected by the product. All this is necessary if the compound is to possess vacuum holding qualities and resist the heat processing so that the result is an adequately processed product in an airtight can.

Inside Enamels.—The use of inside enamels became quite extensive during World War II when electrolytic tin plate was substituted for hot dip tin plate as a tin conservation measure. Inside enamel is used primarily in cans for processing meats to eliminate sulphide discoloration on the inside of the container and the product. Also, enamel is used to reduce can corrosion for such products as chile con carne.

Many meat products contain ingredients which attack can enamels and this, therefore, requires careful selection of the enamel for a particular purpose. Ingredients such as spices, fats, oil, acid, and liver attack certain enamels. Highly spiced products exert a softening effect on enamel coatings. This applies particularly to those spices which have a high volatile oil content.

For the prevention of sulphide discoloration an enamel in which zinc oxide is incorporated has been found to be most effective. However, such a coating has very little resistance to acids. Therefore, its use is avoided for products containing vinegar or a large proportion of tomato products.

Can Storage.—The location of the area in which the empty cans are to be stored is as close to the canning lines as is possible and still maintain good storage conditions. Empty cans are damaged easily and therefore storage space of adequate size and convenient location is provided so that the handling of the empty cans will be reduced to a minimum. Also, the storage space is clean and dry so that the cans will remain free from rust and dirt. It is desirable to furnish some heating facilities in the storage area to prevent wide variations in temperature between the cans and the surrounding atmosphere to avoid condensation of moisture on the cans.

Lithography.—It is common practice for meat canners to have their labels lithographed directly on the tin container. Under adverse conditions

the lithography may be partially obliterated either chemically or mechanically. Of the two, chemical obliteration is the one most commonly encountered. The chemical removal of lithography sometimes occurs in the retort during the heat processing and is caused by boiler compound. Under certain adverse conditions the surging of the boiler may expel some of the alkaline compound along with the steam which is carried into the retorts.

The chemical lifting of the lithography may also occur during the washing of the filled can after it leaves the retort. It is the common practice to wash the filled cans following the steam pressure cooking to thoroughly clean the surface of the can to enhance its display characteristics. A mild detergent such as trisodium phosphate is usually used for this purpose. This cleaning operation may attack the lithography when the concentration of the detergent in the washing solution is too great or when the time that the can is exposed to the detergent is unduly extended. Also, an inadequate rinsing following the washing operation may allow traces of the detergent to remain on the container. The other method of washing the canned product is to thoroughly clean it prior to placing it in the retort. This has the advantage of thoroughly cleaning the can before the heat processing cooks the soil onto the external surfaces of the container. The same safeguards are necessary here to avoid partial removal of the lithography by solutions of detergents that are too strong or by inadequate rinsing that permits a residue of the detergent to remain on the container.

Vacuum.—Air is present in most canned foods after the can is filled and before the top is sealed on the can. This air occurs in voids in the product, as occluded and dissolved air in the product, and in the head space above the product. The earliest method of removing air from canned foods was by heating the product in the can before closure. Later, the method of removing the air by vacuum was developed. Each method is still widely used depending somewhat upon the type of product, conditions of operation, and degree of vacuum that is desired in the closed container.

Various methods of pre-heating foods in the can prior to closure are used for obtaining vacuum in the closed can. The product may be heated prior to filling or after filling or it may be heated both before and after filling. The heat is used to expand the product, to expand and drive out the occluded and dissolved gases in the product and to rarefy the air in the head space before closure. The length of time that the heating is conducted and the final temperature attained before closure have direct relationship to the ultimate vacuum in the can.

At any given temperature variations in the amount of head space will also affect the final vacuum in the can. As the amount of head space decreases the vacuum increases quite rapidly.

The amount of air in the void spaces and that occluded and dissolved in the product is variable depending on the particular product and the method used in its mixing and filling. Many processors mix under vacuum the ingredients of a product prior to its being placed in the can. In any case, the amount of heating that is necessary to exhaust a particular product to the degree that it will give the desired vacuum in the closed can can only be determined by actual test. It has even been found that a short, high

temperature heating will result in a lower vacuum than if a longer time at a more moderate temperature is used.

Under practical closing machine conditions it appears that the vapor pressure relationship for displacement of air in the head space does not play a significant role until temperatures of almost boiling are reached. This is probably due mainly to the disturbing currents of air around the closing machine. Consequently, until closing temperatures almost reach the boiling point, the major factor in producing vacuums in cans having a head space is contraction of the product after cooling.

Mechanical Vacuum.—With this method the filled can while cold or at a rather low temperature enters the closing machine where the cover is loosely clinched on the can without forming an airtight seal. The can then passes into a vacuum chamber with which the closing machine is provided. The can is then subjected to a vacuum for an instant in the vacuum chamber and the can is sealed by clinching the cover tightly on it. The sealed can is then ejected from the vacuum chamber.

This method of exhausting air from canned foods subjects the contents of the can to a vacuum for a rather short period of time before closure. Therefore, the air is withdrawn mainly from the head space and only partially from the product itself. This method of exhausting air from the canned product is well adapted to solid products, such as hams and similar cuts of meat. When it is used for canning chopped products the ingredients of the chopped product are usually mixed under vacuum to eliminate the voids in the product and the occluded and dissolved air.

Closure.—The sealing of the cover on the can, or closing or double seaming as it is called in the industry, is one of the most important steps in the canning procedure. The sealing compound originally present on the cover supplies the material between the layers of metal necessary to insure a permanent, hermetical seal of the container.

Each can as it leaves the closing machine is examined to detect imperfect closure. This examination is necessary not only to pick out those cans which have not been closed properly so that their contents will not be contaminated during the heat processing that follows, but should a closing machine become out of adjustment a large number of defective cans will be produced before appropriate correction is made.

Heat Processing.—The objective of heat processing of canned foods is to heat the food in the can to that degree that will prevent enzymatic or microbiological activity in the food during ordinary conditions of storage. The adequacy of the heat processing is determined by the length of time that the food must be subjected to a given temperature in order to accomplish this objective. The destruction of the enzymes, molds, and yeasts presents little or no problem since these common causes of food spoilage are relatively easily inhibited or destroyed in heat processes as they are carried out commercially. The major problem in heat processing is the control of anaerobic bacteria which produce spores capable of growing without oxygen or in the presence of a limited amount of oxygen. It is the destruction of these spores which represent the most heat-resistant phase of the bacterial life cycle, that requires the most attention.

From the standpoint of heat processing requirements foods are classed

in two types, the "acid" foods have a pH below 4.5 and the "low-acid" foods with a pH of 4.5 or above. Common examples of acid foods are fruits, tomatoes, and sauerkraut. Among the low acid foods are included most vegetables, milk, fish, and meats and meat products.

Usually, the spores of food spoilage bacteria either will not germinate in the acid foods or are easily destroyed at the pH levels of such foods at relatively low temperatures. The same spores, however, if not destroyed will grow and flourish in the low acid foods.

It is possible to process canned acid foods at the temperature of boiling water or even lower depending on the nature of the product and the type of processing operation. The heat processing of canned low-acid foods requires higher temperatures to destroy the heat-resistant spores of food spoilage bacteria.

The heat processing requirements for canned foods are accurately determined since the majority of them are sensitive to heat and deteriorate in quality if cooking is too prolonged. In general, the shorter the process the better the quality of the food in the finished canned article.

Canned Ham.—Until 1930 with few exceptions American meat canners pre-cooked cured hams before canning. Canned hams imported from European countries prior to that time became very popular in the United States. The principal difference in the processing of the American canned ham and the European canned ham was that the Europeans did not precook the ham before placing it in the can. The only cooking that the European canned ham received was that resulting from the heat processing of the ham sealed in the can. Since 1930 practically the entire volume of canned cooked hams prepared in the United States follows the European practice of placing an uncooked cured ham in the can and heat processing it after sealing it in the can.

Hams that are intended to be canned are cured by the sweet pickle method using the quick curing process in which the pickle is injected into the arterial system of the ham. The amount of pickle injected into the ham is limited to that which will hold the gain in weight of the ham during the curing process to not more than 8 per cent. The cured ham is sometimes given a very little smoke as part of its preparation for canning. In all cases it is boned. The ham is skinned with a small amount of skin sometimes being left attached to the ham at its shank end. The excess subcutaneous fat is also removed from the ham before it is placed in the can.

The canned hams are heat processed in hot water to reach a temperature throughout the canned article of not lower than 150°F. and usually not higher than 160°F. This degree of heat processing does not protect the canned ham against spoilage under all conditions of storage. Accordingly, it must be held under refrigeration and its label bears the warning "Perishable, Keep Under Refrigeration." Attempts have been made to subject canned cooked hams to a degree of heat processing adequate to protect them against spoilage under ordinary conditions of storage but they have proved to be unsatisfactory due to the fact that the high degree of heat and the length of time required for heat penetration produces a canned article that is not competitive with the one that is sold under the warning "Perishable" statement.

Luncheon Meat.—This popular canned product is for the most part prepared exclusively with chopped pork. Small amounts of chopped beef are sometimes mixed with the chopped pork, however, it is necessary that the article consist predominantly of pork to give it desirable qualities of juiciness and taste. The chopped meat is mixed with one of the curing mixtures consisting of salt, nitrate, nitrite, and sugar. Water not to exceed 3 per cent of the total ingredients is used to facilitate the mixing and distribution of the curing materials uniformly throughout the chopped product. Flavorings and spices are also added to the mixture.

The mixing of the chopped meat and the added ingredients is usually done under vacuum for the purpose of excluding any air that might otherwise be trapped in the product during its mixing. This properly prepares the mixture for canning since it is not pre-cooked prior to canning and the exhausting of the canned product prior to closure is performed in the vacuum chamber of the closing machine. The pull of the vacuum on the canned product is so transitory at this point that any air which might be trapped in the product would not be exhausted from it.

Luncheon meat is processed in a variety of container sizes. Those sizes that are displayed on shelves in the retail stores and exposed to room temperature are heat processed to a degree that accomplishes commercial sterility. These sizes range from the popular 12-ounce container to the 3-pound size. The larger sizes ranging from 3 to 6 pounds are not heat processed to a degree that would make them stable under ordinary atmospheric conditions. These sizes are labeled with the warning statement "Perishable, Keep Under Refrigeration," and are kept under refrigeration during their handling incident to retail distribution.

Corned Beef Hash.—This canned product consists of a mixture of diced potatoes, chopped corned beef, onions and flavoring materials such as spices and spice extractives. The chopped corned beef consists of at least 35 per cent of the total ingredients computed on the weight of the cooked and trimmed meat. The cooked meat represents 70 per cent by weight of the uncooked meat used.

Generally, the ingredients are mixed and heated thoroughly in a cooking kettle and the cans are filled with the hot mixture. Thermal exhaustion of the air in the product and the can usually precedes closure.

Chili Con Carne and Chile Con Carne With Beans.—Chile con carne consists of a mixture of chopped meat and a thick gravy highly seasoned with chili peppers. The meat consists of 40 per cent of the total ingredients computed on the weight of the fresh meat used. Chili con carne with beans is a mixture of beans, chopped meat and gravy, with the meat making up 25 per cent of the total ingredients also computed on the weight of the fresh meat. In both cases the mixture may contain up to 8 per cent individually or collectively of cereal or soya flour. These products are made by mixing the ingredients in a cooking kettle where they are heated thoroughly and the hot mixture is placed in the can. Thermal exhaustion is relied upon preparatory to closure.

Stews.—Beef stew and lamb stew are the stews usually canned by meat packers. They contain not less than 25 per cent of meat computed on the weight of the fresh meat and the other ingredients are those usual to

stews such as a variety of vegetables and gravy. The mixture is heated thoroughly in a cooking kettle and it is filled hot into the can. Thermal exhaustion precedes closure.

Deviled Ham.—This is canned finely chopped ham that has spreading consistency. Cured hams are cooked and chopped and the finely chopped meat is mixed with spices. The hot mixture is filled in the can and thermal exhaustion is relied upon prior to closure. The canned product does not contain any more moisture than is normal to fresh ham and the fat content is limited to 35 per cent.

Tamales.—These are canned either in sauce or a slightly saline solution. The tamale is formed by enclosing a center of meat mixture with a covering of cornmeal mush. The tamale is then sometimes enclosed in a parchment wrapper or a clean cornhusk. The meat content of the canned tamales is not less than 20 per cent of the total content of the can. The tamales are packed upright in the can and the can is then filled either with the hot sauce or hot salt solution. Before closure the filled can usually passes through a heated chamber for the purpose of subjecting the can to thorough thermal exhaustion after which it passes through the closing machine.

Liver Products.—Liver spread is the one most commonly canned. This product contains at least 30 per cent liver mixed with a paste having a base of farinaceous materials or soya product. The mixture is prepared in a cooking kettle and filled hot into the can. Closure follows thermal exhaustion.

Spaghetti With Meat Balls and Sauce.—The cooked spaghetti, meat balls and sauce are filled separately into the can. The amount of meat used constitutes not less than 12 per cent of the total canned mixture and this is computed on the weight of the fresh meat. The meat balls are usually prepared with not more than 12 per cent singly or collectively of farinaceous material, soya flour and dried skim milk. The sauce is quite hot when it is added to the can covering the spaghetti and meat ball components. The filled can is then usually passed through a heated chamber where thermal exhaustion is completed before closure.

Sausage.—Viennas and frankfurters are the sausage products most commonly canned. The 4-ounce can of viennas is the most familiar product. Frankfurters are usually canned in the 12-ounce size. These sausage products are usually canned in a light brine which is not included in the statement of the quantity of contents on the label. When the viennas and frankfurters are prepared for canning the ingredients are usually mixed under a vacuum so that all voids are eliminated from the product. Usually the viennas are not linked but are cut in sections just large enough to fit the can. Each can is packed snugly with the particular sausage product and a hot light brine solution is poured in the can to fill up the spaces between the sausages and between the sausages and the container. The filled cans pass through a heated chamber to effect a thermal exhaust prior to closure.

The processing of canned viennas and canned frankfurters is done under careful controls since the sausage as it is removed from the container by the consumer must meet the moisture requirement for sausage which is permitted to be not more than 10 per cent of moisture in excess of that normal to the ingredients used in preparing the product. It is necessary,

therefore, to strike a balance between the moisture content of the sausage as it is placed in the can and the moisture that the sausage will pick up from the packing fluid added to the sausage at the time of canning. This balance can be maintained within the limits for permitted moisture by canning a sausage of low moisture content and packing it snugly in the can so that the amount of packing fluid necessary to fill the empty spaces in the can will be reduced to a minimum.

Rendering.—**Lard.**—Pork fats used in the manufacture of lard come principally from the slaughtering department and from the department where the chilled pork carcasses are cut up into their commercial parts. Fats from the slaughtering department are usually called killing fats or hot fats and those produced in the carcass cutting department are called cutting fats. The principal killing fats are leaf, ruffle, caul, ham facings, and head fat. The cutting fats are principally back fat, shoulder fat, belly trimmings, clear plates, and leaf lard scraps. The fats from different parts of the hog carcass have different degrees of hardness. The fats from the back and around the loin are relatively soft while those from the inside of the animal, such as the leaf, caul, and ruffle, are harder. For example, some of the cutting fats have a titer as low as 36°C. whereas the leaf fat may run as high as 41°C. Hardness of the fats also varies with the feed the animal had received. Fats from hogs fed on peanuts, soy beans, and garbage are much softer than fats from hogs fed on corn.

Cutting fats are sometimes stored for a short period of time in trucks under refrigeration between their removal from the carcass in the cutting department and the time they are placed in the rendering equipment. Killing fats on the other hand cannot be held safely for even a short period because they retain the body heat as they are accumulated in the slaughtering department. Their temperature is ideal for enzymatic action to progress in the cellular tissues of the fat as well as for bacterial growth, and unless they are promptly chilled or heated to temperatures beyond 160°F., decomposition will set in rapidly. Killing fats, therefore, are removed promptly from the slaughtering department to the rendering equipment where their temperature is quickly raised above the danger point.

Refining.—Some lard is refined by what is called the caustic method. The lard to be treated is heated to a temperature of 120°F. and sufficient caustic soda solution is added to neutralize completely the free fatty acid in the lard and in addition sufficient to equal .01 per cent of the weight of the lard to be refined. The lard and the caustic soda solution are thoroughly mixed and the temperature is raised slowly to around 145°F. The heating and agitation are stopped at this point and the lard is permitted to settle. After settling the clear supernatant lard is decanted off and filtered. The refined lard is not only lower in acidity but its smoke point is raised and it has a lighter color. Lard is also sometimes bleached as part of the refining process through the action of decolorizing agents such as diatomaceous earth and activated carbon. The lard to be bleached is heated to a temperature of 160° to 180°F. The decolorizing agents are then added and mixed thoroughly. However, they are not left in contact with the lard over fifteen minutes because they may impair the flavor of the lard if given a long exposure. The mixture is therefore pumped as quickly as possible

through a filter press which removes the decolorizing agents. The lard is recirculated through the filter press until it becomes perfectly clear when it passes to a lard roll or some other type of equipment that will chill it rapidly.

Large quantities of lard must be stored from time to time and this is commonly done in tierces or in tanks. The storage tanks are sometimes equipped with refrigeration coils. When it is probable that the lard will be stored for a considerable period of time it is usually stored as the prime steam unrefined product. This class of lard has been found to possess the best keeping qualities, and the storage in tierces which can usually be accomplished under some degree of refrigeration has proved to be the most satisfactory. The ideal temperature conditions for storing lard range from 50° to 60°F.

The most important point in connection with the storage of lard is that it must be free from moisture and impurities. The flavor and color of the lard should be of prime quality. The storage tanks or tierces must be clean. Another factor of importance is that the lard must be protected from contact with moisture while it is being stored. Its storage temperature should be as close to the 50° to 60°F. range as possible and the lard must not be reheated repeatedly. The storage tanks should be of convenient size and proper design and in a favorable location.

Neutral Lard.—The best quality of neutral lard is rendered from fresh leaf fat. Fresh back fat is also used in the rendering of neutral lard but its quality is sometimes identified as No. 2. As the leaf fat is taken from the carcass on the killing floor it is removed immediately to a cooler where it is spread out and chilled at freezer temperatures for approximately twenty-four hours. The chilled leaf fat is then run through a hasher and dropped into the water jacketed melting kettle. The kettle is provided with an agitator which not only tends to emulsify the hashed leaf fat but circulates it against the heated sides of the hot water jacket. The heating of the agitated material continues until the product in the kettle is raised to about 126°F. where it is held until there is a complete separation of the cellular fiber and the melted fat. This separation is aided by sprinkling very fine salt from time to time over the surface of the material. The agitator is stopped and raised completely out of the kettle as soon as the clear lard shows signs of separating from the tissue. The moisture and cellular tissue settle to the bottom of the tank and the clear lard is siphoned off. The clear neutral lard is filtered, allowed to cool to a temperature of about 118°F. and filled into barrels. The filled barrels are placed in a temperature of about 75°F. for twenty-four hours and then removed to a temperature of about 50°F. At this temperature the lard is allowed to grain for at least three days.

Prime Steam Lard.—The fats are rendered in closed tanks under pressure. Live steam at about 40 to 55 pounds pressure is turned into the tanks and the cooking is continued until the fat is completely separated from the cellular tissue.

The fats to be rendered are dumped into the tank until it is filled within 2 feet of the top. Sometimes this fat is parboiled before it is rendered. This is done in the tank by covering the fat with boiling water which is

said to remove blood and other objectionable materials. The water used for parboiling is drawn off and sufficient water is again added to cover the fat. The tank is sealed and steam is injected directly into the contents of the tank until the desired steam pressure in the tank is attained. It is necessary to vent the air completely from the tank before sealing is completed so that the maximum rendering temperature will be reached. When rendering is completed the lard is drawn off from the rendering tank to a separating tank. In this tank any cooking water which may have remained in the lard is settled out. Every effort is made to remove every possible bit of cooking water from the lard because it contains nitrogenous material that will readily decompose and sour the lard. After settling, the lard is pumped to the receiving tank where it is heated moderately to drive off any remaining moisture. After being thoroughly dried the prime steam lard is ready to be pumped to the refinery or for storage prior to refining.

Dry Rendered Lard.—The fats are rendered in a horizontal tank that is steam jacketed. The contents of the tank are agitated by arms or paddles rotating on a horizontal axis extending the length of the tank. The charging opening of the tank is equipped with a tight-fitting cover which in some cases is fitted with bolts that permit sealing the tank tightly to allow for building up considerable steam pressure inside the tank during the initial stages of the rendering process. This steam is produced from the moisture that is expelled from the fatty tissue during its rendering. Whether or not the tank is equipped for the generation of the steam pressure, the rendering is completed at atmospheric pressure or negative pressure depending on whether the tank is equipped with a condenser for the drawing off of the vapors under vacuum. The separation of the fat from the cellular tissues is complete after the moisture has virtually been exhausted from the contents of the tank. In order that the color and quality of the rendered lard is not adversely affected by overprocessing, it is necessary to determine the end point of the cook very accurately. This is usually determined by the character of the tissue residue which when the rendering is completed has a sandy feel.

Open Kettle Rendered Lard.—Rendering of fats in a large open kettle over a fire was one of the earliest methods of commercial rendering and is employed by many farmers who render fats for their own use. The open kettle is still used commercially to a limited extent, however, the heat is applied to render the fat by a steam jacket surrounding the sides and bottom of the kettle. Usually the fat is hashed before it is placed in the kettle and usually the hashed fat is stirred mechanically so that the heat is distributed uniformly throughout it. As the rendering progresses, the moisture in the material is driven off in a cloud of steam. The rendering continues until all the moisture is driven off and the rendered fat has separated from the cellular tissues which take on the character of light brown, dry cracklings. At this point the lard is separated from the cracklings either by settling it in the rendering tank or by drawing the contents of the rendering tank off into a receiving tank. If the settling is done in the rendering tank, it is facilitated by sprinkling fine salt over the surface of the lard which hastens the precipitation of the cellular tissue. After this the lard is drawn off and filtered.

Where the contents of the rendering tank are drawn off to a receiving tank the lard passes through perforated strainers to strain out the cracklings and the lard is then filtered and runs into the storage tank. The residual rendered fat is removed from the cracklings by pressure.

Lard Flakes.—These are produced by hydrogenating lard using the same process as that employed for hardening vegetable oils. The lard is heated to a temperature well above 200°F. and the hydrogen gas is bubbled through it in the presence of a catalyst. The degree of hardness imparted to the lard can be controlled by limiting the time that the lard is subjected to the process. The hydrogenation process in addition to hardening the lard adds stability to it, however, it does impart a characteristic undesirable odor which is removed by employing a deodorization process similar to that described on page 214. Lard flakes are prepared for the purpose of adding them to shortening or lard to raise the melting point of the mixture.

Rendered Pork Fat.—This category of rendered fat derived from fatty pork tissue was recognized in the 1930's by the U. S. Department of Agriculture. The Department examined into the practices of the American meat packing industry in its production of edible rendered fat from a great variety of edible fatty tissue derived from the pork carcass. It was recognized that all of the fatty tissue used in the process was edible in character, however, a question was raised as to whether it produced on rendering a fat that might properly be identified as lard. It was decided that there is sufficient difference between the fat rendered from uncured killing and cutting fats and that rendered from cured fats, organs, bones, detached skin, ears, tails, large blood vessels, skimmings, settlings, pressings and the like, to justify distinguishing between these two classes of rendered fat. It was decided that the term "lard" would be appropriate for the former and the term "rendered pork fat" appropriate for the latter. Except for the kind of fat used in the rendering process, the preparation of lard and rendered pork fat is quite similar. The processes usually employed are steam rendering and dry rendering.

Edible Tallow.—Killing and cutting fats derived from beef and lamb or mutton carcasses are the materials most commonly rendered in the production of edible tallow. In plants that produce oleo stock, the incompletely rendered residual fatty tissue from this operation is also used in the production of edible tallow. Steam rendering and dry rendering are the processes employed and the fat is separated from cellular tissues at a relatively high temperature. In the steam rendering process the rendering is done under 40 to 50 pounds of steam pressure and in the dry rendering process the temperature is well over 200°F. Edible tallow is a comparatively hard fat and is usually blended with vegetable oils in the manufacture of shortening.

Shortening.—**Shortening Composed of Vegetable and Animal Fats.**—Combinations of vegetable and animal fats have been popular as shortenings for many years. A standard formula consists of approximately 80 per cent of vegetable oil and 20 per cent of edible tallow or oleo stearine. Various combinations of fats are used. In recent years rendered pork fat has been used rather extensively in this class of shortening.

Shortening Composed of Lard.—With the popularizing of a hardened, stable, bland vegetable oil product of high shortening value, it became more and more difficult for the meat packing industry to move lard into consumption at volume and price levels consistent with production volume and cost. To meet this competition the meat packing industry developed a shortening made of lard that possesses physical characteristics comparable to the popular vegetable oil shortenings. That is, the lard is bland, hardened, and of high shortening value. To permit it to be merchandized and handled at room temperature without refrigeration it is stabilized by the addition of an anti-oxidant. To assure that the resulting shortening will have the desired quality and stability, only lard of high quality is used in its manufacture.

Puff Pastry Shortening.—This shortening consists of a combination of vegetable and animal fats with 10 per cent added water and is prepared by the packing industry principally for distribution to bakers. The process of blending the ingredients is similar to that employed in the manufacture of oleomargarine.

Oleo Stock.—This is the rendered fat derived from the killing and cutting fats of beef and mutton or lamb carcasses rendered at a temperature not in excess of 170°F. The fats are first chilled thoroughly in a vat of cold water which also serves to dissolve out any residual blood that might be present in the blood vessels in the fatty tissue. The chilled fat is hashed directly into open kettles equipped with a hot water jacket around their sides and bottom. The hashed fat is agitated mechanically so that the heat will penetrate the mass uniformly and the heating and agitation are discontinued at that point when the liquid fat has separated from the cellular tissue. This usually occurs around 150°F. Finely ground salt is scattered over the surface of the rendered mass and as this settles it carries with it the moisture and cellular tissue, leaving the supernatant clear fat which is drawn off into trucks called "seeding" trucks in which the stock is separated into its oil and stearine content.

Oleo Oil and Oleo Stearine.—The seeding trucks containing the oleo stock are placed in a room where the temperature is maintained at 90°F. After about nine days the temperature throughout the contents of the truck drops to room temperature. At this temperature the oleo stearine is solid and has precipitated out having a white flaky consistency. The oleo oil is liquid at this temperature. The contents of the truck are then stirred vigorously to a granular consistency which prepares them for pressing. The oil is then separated from the stearine by filtering through heavy duck material called filter cloths. The oil is either used directly in oleomargarine manufacture or stored in tierces at 50°F. The stearine either goes directly into shortening manufacture or is placed in a bin from which it is packed in barrels for shipment.

Oleomargarine.—The greatest volume of oleomargarine is prepared with vegetable oils to the exclusion of animal fats. However, a substantial production consists of a combination of vegetable oils and animal fats along with the other ingredients normal to the product. Any edible rendered fat, oil or stearine derived from cattle, sheep, swine, or goats might be combined with the vegetable oils. In any case, the finished

product contains at least 80 per cent of fat. To the fat is added cream, milk, skim milk, combinations of dried skim milk and water or a mixture of these. In making the combination of dry skim milk and water at least 10 per cent of dry skim milk is used. These milk products are pasteurized and are subjected to the action of harmless bacterial starters. The congealing of the fats with the milk products is usually accomplished by quickly chilling the warm mixture of melted fat and milk. This is sometimes done by bringing the mixture into contact with cold water.

Other ingredients which may be used in the manufacture of oleomargarine but which if used do not result in lowering the fat content below 80 per cent, are artificial coloring, sodium benzoate, benzoic acid, vitamin A, vitamin D, artificial flavoring diacetyl, lecithin, mono-glycerides, diglycerides, sodium sulfo-acetate, butter, and salt. The sodium benzoate or benzoic acid does not exceed .01 per cent of the weight of the finished product. The vitamin A is added as fish liver oil or as a concentrate of vitamin A from fish liver oil (with any accompanying vitamin D or with or without added vitamin D concentrate) in such quantity that the finished oleomargarine contains not less than 9,000 U. S. P. units of vitamin A per pound. Lecithin, mono-glycerides, diglycerides, and sodium sulfo-acetate are limited to not more than 0.05 per cent of the weight of the finished oleomargarine whether used individually or in combination.

Chapter

11

MEAT GRADING

Purposes of a Grade Standardization and Its Application to Livestock and Meats.—Class and grade standards for livestock and meats have for their primary purpose the establishment of a system of equitably dividing the normal quality range of a given kind of livestock or meat into smaller unit groups having similar specific uses as an aid to satisfactory sale and purchase. The success of any such standard for livestock and meats depends on its adoption and universal use by the industry. The guiding principle in drawing up grade specifications is that they are sound, practical, and factual. The purpose of specifications is not to emphasize or to stimulate a stricter requirement for the different grades, but to spell out, as by illustration and description, the requirements in terms of extrinsic and intrinsic characteristics that all may understand.

Efficient and intelligent production and marketing of livestock and merchandizing of meat are dependent on a knowledge of consumer preference for quality as identified by grades or some sort of system of segregation applied to the total range of quality. Hence, an understanding of consumer demand is necessary in order to provide producers with a guide to enable them to meet that demand.

Any system of grade standards implies some form of division of the range of quality and other essential characteristics based on factors common to all the units represented in the range. The groupings or grades are not made on a quantity distribution of the class but are based entirely on factors that determine the sum total of the characteristics that distinguish one group from another.

Grade designations then are terms that represent certain fixed degrees of excellence within the range for the purposes of economical and intelligent marketing. The number of grades in each class of meat or livestock is dependent upon the extremities in the quality range and on the number of distinct groups which can be accurately and readily identified by fixed and definite economic meaning and which covers or represents a minimum variation in the essential facts which distinguish one group from another. Grades, therefore, presuppose definite specifications which are thoroughly understood by buyer and seller and which are universally interpreted and applied in a consistent manner.

To be of any value from a practical standpoint any scheme of classifying and grading should fit the needs of the interest which it is designed to serve. It must strengthen the desirable features and unify the trade practices by eliminating differences between markets. This is most effec-

tively accomplished through the adoption and use of grade terms with definite meaning that is generally understood. Grade descriptions must be concise, specific, and easily understood. No grade standard will receive widespread use that fails to meet these requirements nor increase the efficiency of the distribution and marketing of any commodity.

Livestock and the meat obtained therefrom is a most complex commodity varying widely in quality, weight, and many other essential factors. Each specification presents a specific problem for the reason that the meat from different species is not wholly interchangeable as to consumer preference. Furthermore, farmers are not always able to produce the animals in the quantity and of the quality indicated by relative consumer demand for the different kinds and grades of meat.

While the consumer is considered an independent variable in establishing standards, it is apparent that the farmer is confronted with problems involving production that are at times incompatible with consumer demands. The producer is adventurous, often exploring possible departures from the orthodox procedures in production and marketing of his animals. Consumers likewise often get reckless with their food dollar by purchases of new products of unestablished quality or brand. These practices tend to prevent a concentration around any established grade segregation and the so-called liners between grades represent as large a proportion of the specific population as the typical examples of the grade.

The principle of the grading system lends encouragement to this situation when representatives of the grade having the minimum requirements will command as much or more consideration than those having the maximum qualifications of a grade. The continual efforts on the part of the consumer to select meat of a given grade with the greatest proportion of lean to bone and trimmable fat, together with a strong perference for smaller cuts, are having their effect on some ranchers as to the kind of cattle to breed and raise and upon the Corn Belt feeder as to the weight and degree of fatness that provides the popular beef.

Historical.—The course of events that led to the establishment of the Federal meat grading service parallels the development of the livestock and meat industry of this nation. No other country has anything that closely matches it, for the reason that meat production in this country has never been closely geared to a meat export trade or to the preponderant production of any one particular commodity to the detriment of other kinds of meat. The chief outlets for the meat production of the United States have been our own domestic markets. The particular quality or brand of meat consumed has been markedly influenced by the general economic conditions of the country and by the changes in status and types of employment of the people. Of special significance is the fact that the changes called improvements are directly associated with and have been contributory to the constant improvement in the standard of living of the American people.

Back in the days when Mr. J. Ogden Armour and Mr. G. F. Swift, two New England Yankees, and others started in the meat business, slaughtering of cattle and the selling of the meat were almost entirely local enterprises. The so-called butcher bought his meat on the hoof, slaughtered it

and retailed the meat. He was packer, distributor, transporter, and retailer of all that which he slaughtered. The meat was passed over the block with no particular designation as to the quality. In those days beef was beef. Beef grading if conceived in those early days was restricted to those considerations that reflected differences in dressing percentage, commonly referred to in these times as yields.

There were two fundamental reasons why grading as it is practiced today was not actually important in earlier merchandizing practices:

1) The kinds of cattle in any particular area or locality were pretty much the same with respect to type. The degree of fatness varied with the season, the availability of feed, and price relationship between feed and cattle. So-called stall feeding was practiced sparingly, consequently the fatness of the cattle was determined very largely by the supply of grasses and other roughages.

2) Transportation was slow, precarious and restricted largely to local movements. Hence, the butcher depended upon local supplies of cattle for his beef. Consumers became thoroughly familiar with the quality of beef handled by their local butcher, which of necessity was pretty much the same, and changed only with the seasons and abundance of feed naturally provided.

The population multiplied and it spread from East to West. Likewise, the meat business expanded not altogether through the process of fission in which additional small butcher shops continued to be established but rather by consolidation and enlargement through development of slaughtering plants which relieved the retailer of the necessity of operating his own slaughtering plant. The slaughterers and the consumers tended to become more widely separated. The slaughtering of livestock moved toward the areas of production and the population tended to congregate around the areas of industrial development. Thus the focal points of meat supplies and consumption drifted wider and wider apart, the speed and distance being controlled by the development of transportation facilities and the development and expansion of livestock production.

The local butcher business was converted from a single independent business to one more complex in which he became dependent upon some central slaughtering plant for his meat supplies. Movement of meat is in refrigerated cars, consisting of large quantities, far in excess of the amount that could be handled immediately by the individual retailer. A middle man, the wholesaler, was created, one who took over the function of buying in large lots from the slaughterer or the packer and of selling in small lots to the individual retailers. Due to economic expediency wholesalers tended to situate themselves in the vicinity of the retailer areas.

Thus another complexity was introduced into the marketing processes which made it impractical for the wholesaler to personally examine and select the meat he purchased prior to the arrival at his place of business. Furthermore, the retailer found it increasingly burdensome on his time to personally examine and select his meat prior to purchase. The problem of purchasing uniform kinds and quality of meat was greatly accentuated by improvements in the breeding and management of livestock on the farm and ranches, which, for a time, had the effect of widening the range of

quality. Hence the need for some practical means of describing quality as a substitute for presale examination of the meat led to the use of numerous descriptive terms having some quality significance.

The first approach to the problem was the identification of beef with the geographical origin of the cattle. In some parts of the country this practice is followed even today. The Southeast continues to feature Western Beef and K. C. Beef. Such references as Range Cattle, Cornbelt Cattle, Native, and others are still used to signify or imply a particular quality of beef.

As production of livestock took on the role of high specialization in meat production and felt the influence of superior breeding and skilled management in the feedlots, such terms became practically meaningless. Other means of segregation became necessary in order to depict the narrower ranges of quality. To meet this demand such terms as Choice, Good, and Medium, and Western or Native came into common use by the trade. Just recently, a new term "genuine fed", inferring fattened on grain, has been proposed. Like many of the other designations intended to imply differences in characteristics of meat, "genuine fed" offers no tangible way of distinguishing the meat from grain fed animals as different from some similar in characteristics but not grain fed.

Cattle and sheep are so improved in accordance with the single objective of meat production that when fed in the Cornbelt for varying periods of time they lose much or all of the characteristics that identified them with the point of origin. Notwithstanding the marked development of the livestock industry toward a single standard, many of the original terms remain in usage even though they furnish no dependable reference to the quality of the meat.

As the meat industry expanded, the problems of identifying quality became more and more complicated since every handler was attempting to use a nomenclature of terms largely of his own choosing but which did not necessarily coincide with those of others engaged in similar business. Meanwhile the cattle producer and the sheep producer were forging ahead with an intensive program of improving their animals through the use of superior breeding stock and application of scientific methods in feeding and management only to run head-on with the confused and baffled consumer who was unable to recognize with confidence the improved and better meats from the other kinds due to the maze of terms employed by packers and wholesalers in identifying difference in quality of meat. Demand for uniform standards for meat grades rapidly developed throughout the livestock and meat industry as well as the consuming public. The demand was manifested through complaints from individuals and various organizations over a period of years. Consumers in all sections were continually being disappointed by their meat purchases and demanded some means by which they could determine high grade meat from the lower grades.

The lack of uniform standards had caused much misunderstanding, confusion, suspicion, and in some cases material losses, and every instance tended to pressure for the adoption of uniform national grade standards.

The first attempt to develop a uniform standard using grade terms

nationally understood was undertaken in 1902 by the Agricultural Experiment Station of the University of Illinois. The results of these studies provided the basis upon which the United States Department of Agriculture in 1916 set up tentative standards for the classes and grades of beef and for the preparation of Market Classes and Grades of Beef. These were published in 1924, as Department Bulletin 1246, the first of the grade standards issued by the United States Department of Agriculture. In these standards were embodied the fundamental principles of meat grading, first used in market news reporting work.

Federal Meat Grading Service.—The Federal grading of meat was first inaugurated by the United States Department of Agriculture in 1923 as a special service to the United States Shipping Board for the emergency fleet and other United States owned vessels to alleviate difficulties encountered in procurement of desired quality of beef. During the next two years the service was extended to other steamship companies, railroads, large hotels, followed by requests from Federal, State, and county hospitals and other governmental institutions and still later from wholesale meat dealers, chain stores and others.

After the grading service had functioned for about two years a series of meetings were held for the purpose of obtaining from the trade, criticisms, comments, and suggestions concerning the proposed standards. It was the general consensus that universal standards were highly advisable but considerable doubt was expressed by some as to the possibilities of uniform application of such standards. These meetings created widespread interest among the producers of livestock and the meat trade, especially those producers handling high grade cattle. Steps were taken forthwith by these producers to organize and support a general movement toward the adoption and extensive use of uniform official standards for both livestock and meat. The firm conviction of the leading cattle breeders and feeders in the principal cattle producing states led to the formation of an organization—The Better Beef Association—for the specific purpose of sponsoring the grading and grade stamping of beef.

The Secretary of Agriculture made a commitment to the Association to supervise the grading and grade stamping of beef for one year provided some satisfactory agreement could be reached between producers and packers.

At the end of the year a conference was called by the Secretary of the National Live Stock and Meat Board at which time definite plans were formulated for the development of the grading service and the date determined for inaugurating the service. Accordingly, the beef grading and stamping service was officially inaugurated on May 2, 1927, by the United States Department of Agriculture.

When the grading service was first installed it was agreed that only Prime and Choice beef would be grade stamped. Before the end of the first year the demand for graded meat had developed to the extent that the grade Good was added and within five years the grading program had to be further extended to identify steers, heifers, and cows with a complete schedule of grades.

The grading program made a very substantial growth during the first

five years despite numerous handicaps. Much educational work was performed by organizations favorable to the program to acquaint potential users of graded meat with the benefits to be derived from grading. This phase of the program was planned and directed by the Better Beef Association and the National Live Stock and Meat Board. The distribution of effective information by these two organizations created an enormous consumer demand for grade labeled, high quality beef, with the result that many opponents among the wholesale trade joined the supporters of the service in making graded beef available to the consumer, thus giving assurance that the grading program was fundamentally sound and practical. Its future success rests largely with two major accomplishments, neither of which has as yet been entirely mastered. This refers to the development of a grade standard in which the human element plays a minor role in determining the grade and, secondly, an objective measure of the factors that determine the grade in a manner intelligible to the retailer and consumer.

Three primary factors involving all the characteristics of the beef carcass are carefully considered in developing grade standards. They are conformation or shape, finish or degree of fatness, and quality.

The grades of meat are determined almost exclusively upon the exterior physical characteristics. While it may be true they are indicative of the relative acceptability of the meat, such limited considerations are not always dependable. The characteristics that are responsible for quality often are not discernible by the consumer. Many are aware of the importance of ageing in the development of flavor and tenderness but few can determine by examination whether or not the meat has been properly and adequately subjected to the process.

The extent to which marbling should be allowed to replace exterior fat as a consideration of finish in determining grade needs careful study. Incidentally marbling is a characteristic that can be quantitatively measured and charted, according to grade by weight and age. The matter of age in animals and its influence on grade has never been satisfactorily determined. The degree to which ripening of meat will compensate for age is another consideration that needs study.

The grading of all meat is performed in accordance with some standard, whether expressed in the form of written specifications or in accordance with points of view developed during the course of experience. Other characteristics inherent in meat or developed after processing may have a profound influence upon the nutritive qualities, as well as the edibility of the meat. None of these characteristics is considered in the determination of the grade of meat except insofar as they may be associated with certain of the physically apparent characteristics observed in formulating a decision as to the appropriate grade.

The actual performance of grading service is confronted with two principal problems; one, the establishment and maintaining of consistent interpretation and application of the grade standard by the individual grader, and two, getting all the graders to apply the standards uniformly.

The difficulties in the first case emanate in large measure from the individual grader in the application of his own system of grading. He, of

necessity, must draw continually on his experience which in turn was obtained under the direction of some private operator. Hence difficulties encountered in determining the grade according to the Federal Standard obviously tend to be solved in light of knowledge previously gained which, in many cases, is at variance with that employed by the Federal Meat Grading Service. Much time and training are often required to adjust the performance of a group of graders to a uniform method and procedure of grade analyses. But before such a task can be undertaken, it is necessary that all the teachers are in agreement and can demonstrate the interpretation and application of the standards uniformly so that every grader is being taught to apply the grade standards in a manner as nearly alike as is humanly possible to teach by demonstration.

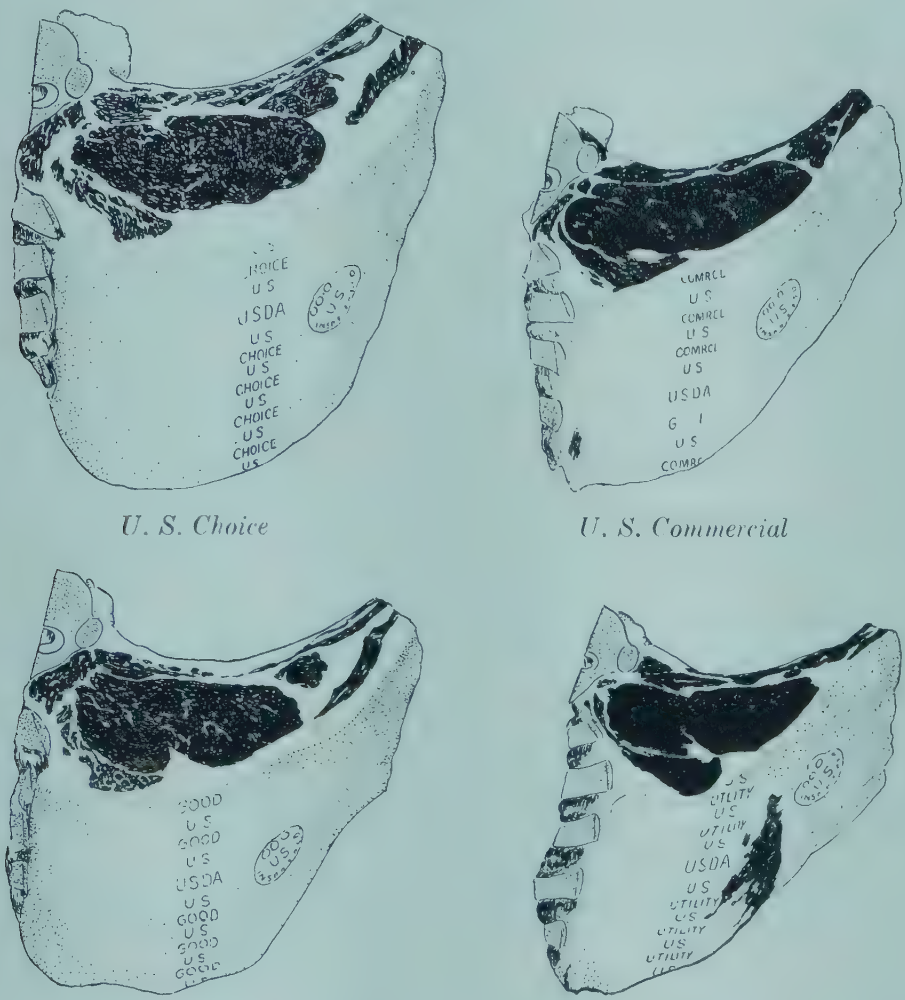
Organization of the Federal Meat Grading Service.—Applicants for the grading service are grouped in small units called areas. An area may require the services of 6 to 20 graders. In each area is assigned a grader supervisor whose principal duty it is to work out grading schedules or itineraries for the graders and to maintain consistency and uniformity in the performance of the grading work. He spends almost his entire time with his graders reviewing their work and giving instructions as to the proper interpretation of the standards. He is also available to discuss standards with applicants and give grading demonstrations to interested groups.

It is not sufficient to have each area grade consistently, they must apply the standards uniformly with other areas. This is accomplished by grouping areas under the direction and supervision of a regional supervisor who has as his main duty the development and maintenance of a high correlation of consistency in the application of the standards between the areas assigned to him. There are seven of these regional supervisors and they constitute a committee frequently called into conference to discuss the technical and administrative phases of the grading service and particularly to participate in a correlation grading school of two days duration. Similar performances are conducted by regional supervisors in the areas of their respective regions.

Heading up the field organization is the National Supervisor and his supervisor assistants who travel the width and breadth of the country checking the grading in the different regions and seeing to it that the standards are being uniformly applied on a nation-wide scale. There are other men stationed at strategic points who spend their entire time reviewing the grading of beef shipped in from different slaughterers. Daily reports are made of their observations. Flagrant misgradings are promptly reported by wire to the supervisor in whose area the error was made. In this manner mistakes are properly and most effectively corrected. Complaints and appeals are also filed by financially interested parties to which appropriate response is made, usually by Regional Supervisors.

Finally, grade standards are considered an important part of the meat marketing system. Regardless of the supply or the demand, the matter of quality differentiation is involved. Those differentiations should be generally understood by the trade and capable of practical application. Consumers are encouraged to eat more meat when assured of a consistent

quality with respect to what they believe they are buying. A sound meat merchandizing program must be founded on uniform standards universally applied and respected.



U. S. Choice *U. S. Commercial*

U. S. Good *U. S. Utility*

FIG. 86.—U. S. Choice, U. S. Good, U. S. Commercial, U. S. Utility. (National Live Stock and Meat Board.)

Chapter

12

ADULTERATION AND MISREPRESENTATION

Adulteration.—Meat and its products during their handling and processing preparatory to being shipped to the trade may pick up or have added thereto substances that affect their wholesomeness. Also, unless appropriate inspectional control is exercised ingredients may be added to meat products which are not normal to them and therefore would not be expected by the consumer to have been used in their preparation. Furthermore, since the merchandising of meat and meat products is a commercial enterprise, there is always the temptation to substitute for one ingredient another ingredient of lesser cost or add excessive quantities of inexpensive ingredients, such as water, farinaceous materials, fat, and the like.

Affect Wholesomeness.—The wholesomeness of meat and meat products may be affected adversely by adulteration with contaminants such as filth, foreign substances such as fingernail polish, staples, tag fasteners, and the like, and chemicals of many kinds. The wholesomeness of meat and meat products may also be adversely affected by adulteration with materials that lower the nutritive value of the food. Adulteration with toxic ingredients obviously would make a food unwholesome.

CONTAMINATION.—*Dirt (filth).*—A great deal of emphasis has already been given in this text to the handling and preparation of meat and meat products in a way that will eliminate all diseased and otherwise unfit carcasses and parts of carcasses. In the chapter devoted to facilities relating to sanitation in plant operation, the field of environmental sanitation is reviewed in considerable detail to focus attention on the necessity for providing a clean environment in which meat and its products can be handled to avoid contaminating them with many kinds of dirt and filth. In addition to eliminating dirt and filth from the environment, inspection supervision guards against the adulteration of the food with decomposed or otherwise spoiled meat, meat products or other ingredients.

The materials that are added to meats during their preparation into many kinds of meat food products are examined to assure that only those that are clean and fit are used as ingredients. This refers to ingredients such as those mentioned in Chapter 9 which deals with materials added to meats.

Mechanical. Care is constantly exercised to avoid the adulteration of meat and its products with metallic particles and similar foreign material which they may pick up or which may drop into them as they progress through the meat packing plant.

The edges of shovels used in the handling of chopped and ground meat

may wear thin, roll, and crumble into the meat product. This applies more particularly to shovels made of soft metals, such as cast alloys.

Staples from metal stitching machines are a dangerous source of contamination for meat. For this reason, stapling machines are not operated adjacent to exposed meat or open containers of meat. Care is exercised when opening wire bound boxes of meat to see that no loose staple becomes imbedded in the inclosed product.

Metal tag fasteners and wood and metal skewers are used in the identification and preparation of carcasses in the slaughtering department. Unless care is exercised to see that all such articles are removed from the carcass before it is taken to the cutting department, they might become imbedded in and contaminate the production of meat trimmings.

Welds are a probable source of contamination of meat with metal particles. Sometimes metal beads and pieces of slag adhere loosely to the surface of newly welded joints in the bodies of metal trucks and similar metal equipment used for handling meats. Also, particles of metal may become loosened from poor welds and become imbedded in and contaminate meat. Beads of solder may contaminate meat products in tin cans. These beads may be formed and left loosely adhering to the side of the can when the crimped edges joining the side of the can are soldered. Lacquers applied to the inside of tin cans sometimes become detached from the surface of the can after it is filled with the meat product, closed, and processed. When this occurs, the product in the can becomes adulterated with particles of lacquer.

Meat is guarded against contamination by glass from all probable sources. Light bulbs are protected when suspended directly over choppers, grinders, mixers, and similar equipment. Burned-out light bulbs are placed in rubbish containers immediately upon being removed from the electrical fixture. Milk, beverage, and other glass bottles are not brought into departments where meats are processed. Broken or cracked window panes are removed carefully and promptly from their sash and all windows are kept in a good state of repair.

Scaling paint, dust, and flaking rust are not permitted to accumulate on overhead structures. Meat and its products are not stored or handled in areas where condensation is formed on overhead structures from which it might drop into the food.

Plaster, brick dust, and particles of concrete might drop into and contaminate meat and meat products from walls or posts constructed of masonry materials and which are not protected by suitable guard rails. Particles of these materials may be dislodged by trucks or other containers of meat bumping into or scraping against the walls or posts.

Care is exercised to see that grease or oil used to lubricate trolleys, conveyor chains, and gear boxes does not drop into and contaminate meat and its products.

A great variety of miscellaneous materials such as nails and splinters from barrels and boxes used as containers of meat may contaminate the food. Particles of metal may be detached during the opening of tin cans. Even particles of wire broken from bacon hangers and belly spreaders may find their way into and contaminate meat. Considerable care is necessary

to avoid contaminating meat with particles of burlap when the burlap cover is removed from slack barrels containing meat which is received at the packing plant for further processing.

Chemical.—Equipment.—The chemical composition of the surface of food handling equipment must be such that it will not adulterate the food with a chemical contaminant. Copper kettles are given a heavy protective coating of tin so that the meat or products placed in the kettles are not adulterated with copper salts. Cadmium is not used as a plating for or in the composition of metal food handling equipment. The meats or meat products placed in equipment coated with cadmium will pick up toxic quantities of the metal. Solder containing cadmium is not used.

Food is not permitted to come in contact with lead surfaces which may contaminate it with toxic quantities of the metal. Solders containing an excess of 5 per cent of lead are not used. There is available a so-called silver solder which does not contain either lead or cadmium, for use where welding is not practicable on metal equipment.

Plastics used as coatings for food handling equipment may contain toxic chemicals that are used as plasticizers, stabilizers, or antioxidants. The use of plastic coatings containing such toxic substances is avoided since meats coming in contact with them may be contaminated with significant amounts of the toxic material.

Detergents or sanitizing agents are rinsed thoroughly from the surfaces of food handling equipment so that no residue may remain to be picked up and contaminate the meat or product which comes in contact with the improperly rinsed surface.

Containers, Wrappers, and so forth.—Fast colors and inks are used in coloring and printing wrappers used for packaging meats. Unless the color is fast it may run and contaminate the meat in the package.

Care is exercised to see that plasticizers, antioxidants and stabilizers used in plastic wrapping materials are non-toxic since the same considerations apply as with the use of plastic coatings for food handling equipment (supra).

Aluminum foil has replaced lead foil in the packaging of meat products. At one time it was a common practice to package bouillon cubes in lead foil. This practice was discontinued to avoid the probability of adulterating the cube with lead contaminant. It is necessary to give some attention to this item because aluminum foil is not quite as suitable as a packaging material as lead foil. This is because aluminum foil tends to spring open after it is folded while there is no spring to lead foil.

Lead Seals.—It is the practice, principally in identifying kosher products, to attach what is called a lead and wire seal to the product. This sealing device consists of a wire having a metal disk on one end perforated for the insertion of the loose end of the wire. Before the loose end of the wire is inserted into the metal disk, it is passed through the piece of meat to be identified. After the end of the wire is inserted into the metal disk, pressure is applied to the disk and both ends of the wire are secured in it. Aluminum has been substituted for lead as the metal in the disk. Lead responds better to pressure than aluminum and it is preferred for this purpose.. However,

since the disk comes in direct contact with the meat, it is objectionable as being a probable source of lead contamination of the food.

Pesticides.—Meat may be contaminated with chemicals brought into the animal on its food in the form of pesticides applied to forage. Chemicals may also enter the body through the skin of the animal when insecticides are sprayed directly on the animal or used in dipping vats. Those that are toxic for humans are, of course, the most objectionable. These include organic phosphates and some of the chlorine compounds which include chlordane and DDT. Benzene hexachloride is objectionable for the additional reason that it imparts a disagreeable odor and taste to the food that it contaminates.

Constant attention is necessary to control the use of rodenticides and insecticides in a meat packing plant to avoid contamination of meat and meat products with these toxic chemical substances. The use of pesticides in meat packing plants is discussed beginning on page 130 in Chapter 7.

Drugs, Medicines.—Aromatic medicinal preparations that are administered to animals a short time before slaughter sometimes can be detected when inspections are made because of an odor imparted to the meat by the medicine. Such meat is considered as being adulterated with a chemical, namely, the aromatic medicine.

Thiouracil has been used experimentally as an aid to fattening livestock. The ingestion by food animals of thiouracil carries into their carcasses a chemical contaminant that must be classed as adulteration of the meat, unless the animals have been allowed sufficient time (two days) to eliminate the chemical before slaughter.

Lower Nutritive Value.—Proposals are received from time to time to use mineral oils in place of food oils and fats in the preparation of meat food products. Such use of mineral oil is classed as an adulteration that affects the wholesomeness of the food to which it is added because it has no nutritive value and replaces a food fat which has nutritive value. Furthermore, it affects the wholesomeness of the food with which it is used because it tends to dissolve nutritive elements of the food such as the fat soluble vitamin and interferes with its assimilation by the body as it passes through the digestive tract.

Solutions of agar possess the physical characteristic of remaining solid at temperatures that will liquefy solutions of gelatin. For this reason, agar is occasionally proposed for use as an ingredient of a meat food product intended to be merchandised in a jellied condition. Agar is an inert substance. It has no nutritive value and passes through the digestive tract unchanged. It is considered, therefore, to be an adulterant that affects the wholesomeness of a food were it used as an ingredient. However, it is used as a packing medium. For example, a whole cooked beef tongue might be placed in a can and the spaces between the cooked tongue and the can filled with agar solution. There is, of course, no adulteration of the cooked beef tongue with agar because none of it enters the tongue. Such a canned article is labeled "Beef Tongue, Packed in Agar" and the statement of the quantity of contents on the label does not include the weight of the solution of agar that is used as a packing medium.

Toxic Ingredients.—Enterprising food processors are continually

developing new substances that they propose as ingredients of meat products. These substances have a great variety of uses. Whether or not such new substance might be appropriate for the intended use, the first consideration goes to a determination as to whether it is non-toxic. Examples of such substances are preservatives, antioxidants, synthetic emulsifiers, and flavorings.

Hydroquinone was proposed for use as an antioxidant in rendered animal fats. It was demonstrated to possess definite antioxidant effect when added in very small amounts to the fat. Exhaustive toxicity tests were conducted to determine its acute toxicity rate and its chronic toxicity rate. Such tests consist of controlled animal feedings that usually require two years of observations on rats and shorter periods on larger animals before a definite determination can be made that the substance is non-toxic. In the case of hydroquinone it was found that long-continued feedings demonstrated that it gave chronic toxic results. Hydroquinone was therefore ruled out as an ingredient of edible rendered animal fats. Due to its toxic qualities, it is considered to be an adulterant that would affect the whosesomeness of the food to which it is added.

Nitrites and nitrates are permitted to be used in the preparation of meat and meat products within the limitations specified on page 385 of the Appendix. In amounts beyond these limits the nitrites and nitrates are classed as toxic ingredients that would affect the wholesomeness of the food amounting to an adulteration. Within the prescribed limits, the nitrites and nitrates are permitted to be used because they have been used traditionally in the preparation of meat and meat by-products and their use is necessary to the production of the class of products usually referred to as being cured.

Inappropriate or Unexpected Ingredients.—Foods may be adulterated with entirely wholesome ingredients when those ingredients are inappropriate for the particular product or not expected by the consumer to have been used in the particular product. An ingredient may be an adulterant if it is used as a substitute for another ingredient when the latter is expected by the consumer to have been used in the preparation of the food. When an ingredient is used in an excessive amount, that amount in excess of the normally expected food content constitutes an adulterant of the food. Certain odors that are not normal to the food when present as a constituent of the food are in the nature of an adulterant and, therefore, are being included under this heading.

Not Normal.—Adulterating beef with horse meat is one of the more dramatic examples of adulterating one food with another food. Regardless of what might be the practice in other countries or the fact that the consumer of beef adulterated with horse meat may sustain no injury other than an æsthetic one, Americans have a very strong aversion to buying horse meat when they think they are buying beef. The ease with which the consumer may be deceived and the difficulty of detecting horse meat adulteration in beef are examples of the importance of exercising inspection supervision in the meat packing plant where the meat product is prepared, rather than attempt to pick up adulteration in meat as it is distributed to the trade.

There is an inclination to adulterate hamburger with pork. Pork is an inappropriate ingredient in hamburger which has been popularized as an all-beef product and for the further reason that hamburger is quite commonly prepared for consumption by giving it only a superficial heating. Hamburger adulterated with pork, therefore, is potentially dangerous because the consumer may contract trichinosis from consuming uncooked pork.

Lebanon bologna is another all-beef product in which pork is an inappropriate ingredient. This class of sausage is also prepared without the use of fillers of any kind, such as cereal, dried skim milk, and soya flour. Although these fillers are expected by the consumer to be used within the limits of $3\frac{1}{2}$ per cent in certain kinds of sausage, they are not expected to be used in any amount in lebanon bologna.

When the consumer purchases pork sausage he expects it to be prepared with pork to the exclusion of meat by-products or any other kind of meat. Neither does he expect that filler of any kind will be used in its preparation. Accordingly, such ingredients are considered inappropriate for pork sausage and, if used, are adulterants.

In fact, any sausage bearing a designation such as mettwurst or similar name that is associated with an all-meat product would be adulterated were it to contain a meat by-product or a filler of any kind. The same applies to luncheon meat.

Gums and gelatin are inappropriate ingredients of sausage products. These substances would permit the incorporation of excessive quantities of moisture in the sausage and would replace ingredients of nutritive value that are normally used to give the sausage substance and body. That is, the use of gums and gelatin would enable the meat packer to prepare a sausage with less than the expected amount of meat and other nutritive ingredients.

Substitution.—Pimientos are a popular ingredient of many meat food products. They are a delightful source of flavor and color in products in which they are used. Because of this popularity, meat packers desire to display the word "pimientos" on their labels. Such labeling would be appropriate only were pimientos actually used in the preparation of the meat product. Sweet red peppers are much less expensive than pimientos and their use in a meat food product contributes a flavor and color comparable to that obtained with the use of pimientos. Accordingly, there is a temptation to substitute sweet red peppers for pimientos. Where this is done in a product labeled with the word "pimientos" the substitution is regarded as an adulteration of the meat product with an unexpected ingredient.

Pepper is also a very popular flavoring in meat products. In the merchandising of certain products, this popularity is exploited by displaying the word "peppered" on the label in connection with the name of product. An article so labeled is considered as expected by the purchaser to have been prepared with natural pepper. The substitution of ground pepper shells, spice extractive or a substance such as oil of cubeb for the natural pepper in a meat product labeled to indicate the use of natural pepper is regarded as adulteration of the product with an unexpected ingredient.

Similarly, the term "spiced" is a popular one for use in connection with the name of product on labels for meat products. That designation is considered to create an expectancy on the part of the purchaser that natural spices had been used in the food. A substitution of spice extractives for natural spices in a product labeled with the term "spiced" is regarded as amounting to adulteration of the meat product.

Excessive Quantities of Expected Ingredients.—Water is presumed to be expected by the consumer to have been used in the preparation of a product such as sausage, luncheon meat and meat loaves. However, the consumer is entitled to expect that the amount of moisture is limited to that necessary for the preparation of a good product. Limitations on the moisture content of these products have therefore been established. For the purpose of facilitating the chopping of the meat and the blending of the ingredients, up to 3 per cent of water is permitted to be used as an ingredient of fresh sausage, luncheon meat and meat loaves. Quantities of water in excess of this amount if used in these classes of products constitute adulteration because they exceed the expectancy of the consumer. Up to 10 per cent of added water is permitted in cooked sausage and amounts in excess of this percentage constitute adulteration.

Cereal, dried skim milk and soya flour are presumed to be expected by the consumer in certain sausages, such as frankfurters, wieners, bologna, and liver sausage. Here again limitations have been established and amounts of these fillers in excess of $3\frac{1}{2}$ per cent are considered as constituting adulteration.

The consumer is presumed to expect that meat will not be adulterated with excessive quantities of curing solutions. The methods of curing that include injecting quantities of pickle directly into the meat or into its arterial system offer an opportunity to add excessive amounts of curing solution to the product. Curing practices are regulated so that the smoked, cured cuts of meat as they are distributed to the trade do not weigh more than the meat weighed before it was cured.

Because of its availability and lower cost by comparison with meat, there is a temptation to use excessive quantities of fat in preparation of such products as hamburger, deviled ham and pork sausage. Limitations on the fat content of these products have therefore been established. The consumer is presumed to expect not more than 30 per cent of beef fat in hamburger and quantities in excess of this amount are considered to be adulteration. The amount of fat in deviled ham is limited to 35 per cent, and the amount of fat in pork sausage is limited to 50 per cent.

Odors.—Occasionally, meat will pick up an objectionable odor from feed or the environment in which the meat is held. In the early spring, a strong garlic odor will sometimes persist in a beef carcass presumably traceable to ingestion by the animal of quantities of wild garlic. A fishy odor is sometimes detected in the carcass of an animal that had been fed quantities of fish waste. These odors are regarded as being in the nature of adulteration since the consumer does not expect such an odor in meat.

There have been instances where carcass meat hanging in the refrigerator has picked up a persistent creosote odor from tar or creosote material that has been used in the repairing of bunkers housing the refrigeration

coils or the brine spray decks. Ammonia leaks in coolers have been known to impart to the meat hanging in the cooler a persistent odor of ammonia. It is presumed that the consumer does not expect such odors in meat and therefore, they amount to an adulteration.

Misrepresentation.—Purchasers of meat and meat products may be confused or mislead concerning their purchase through misrepresentations made on labels, by the appearance of the product itself, or by the container in which the product is packed. Food may be mislabeled in such a way as to mislead the purchaser concerning the origin of the product. Food may be offered for sale under the name of another food. Its label may misrepresent the product with respect to its composition, quality, or quantity. Also, labels bearing indefinite or vague warranties may mislead a purchaser.

A meat or meat product that is treated in such a way as to mask its inferiority amounts to a misrepresentation concerning the quality of the product as it is offered for sale. Containers in which meat or meat product are merchandised may misrepresent the product both with respect to its quantity and quality.

Mislabeling.—*As to Origin.* Many countries and localities have acquired a reputation for producing certain meat products that are preferred by the consumer. In many instances there is a consumer preference for locally prepared meats. Unless the significance of a geographical term is understood by the purchaser of a product labeled with that term, he may be mislead concerning the origin of the product.

On the other hand, many geographical terms have lost their significance with respect to locality and have acquired a recognized secondary meaning as referring to a kind of product. Terms such as frankfurter, bologna, vienna, wiener, braunschewiger, thuringer, and genoa have come into general usage as generic terms referring to kinds of sausage and are not considered as identifying the locality in which the sausage is prepared. The term "irish" has had long usage as identifying a kind of stew, and when used on labels for this product, is not considered as identifying the locality in which the stew was prepared.

Geographical terms that have not acquired a meaning with respect to a kind of product but have meaning only as identifying a particular locality may be misleading unless the products so labeled are, in fact, prepared in the locality represented by the geographical term. Such geographical terms have been accepted as brand names when followed with the word "Brand" appearing in the same size and style of lettering as the geographical term. In addition, a statement identifying the locality in which the product was, in fact, prepared appears contiguous to the brand name as, for example, "Chicago Brand Bacon, Made in New York."

The terms "farm" and "country" have also been popular for use on labels for meat and its products. These terms if used without appropriate qualification on a label may also be misleading concerning the origin of the product unless it was, in fact, prepared on a farm or in the country. The word "farm" is sometimes used in the brand designation on a product that was not, in fact, prepared on a farm. When it is so used the word is qualified to read "Farm Brand" with the letters in both words appearing

in the same size and style of lettering and the words are accompanied with a statement identifying the locality in which the product is prepared such as "Farm Brand Smoked Ham, Prepared in Chicago." The word "Country" is sometimes used on a label to designate a style of product that has not, in fact, been prepared in the country but is prepared in a way that resembles a product prepared in the country. In such case, the word "Country" is immediately followed by the word "Style" with both words appearing in the same size and style of lettering.

An exception to the foregoing concerning the qualified use of the word "farm" on labels is the use of the term "farmer" which has acquired meaning with respect to a particular type of summer sausage. On labels for this type or sausage the word "farmer" is regarded as being a generic term and is used without any qualifying wording such as "Brand," or "Style" or a statement identifying the locality in which the sausage so labeled was prepared.

Unless foreign-made meat products are identified as to their country of origin, they may be misrepresented to the American consumer as being of American origin. Accordingly, foreign meats are labeled to show that they are products of foreign origin, the label identifying the country of origin.

Names of persons or firms are not displayed on labels in such a way as to mislead the purchaser concerning their significance. When the firm name on a label is the name of the manufacturer or packer of the product, it may appear without qualification or may be accompanied with wording such as "Prepared by John Doe and Company." When the product is not prepared by the person or firm whose name appears on the label, such name is qualified by a phrase which reveals the connection the person or firm has with the product as, for example, "Prepared for John Smith and Co."

Name of Product.—Unless the name of the product on its label is the common or usual one and is appropriate for the particular product, the label may mislead the consumer who makes his purchase of the product relying on its label. Each name represents a product for which there is a standard of composition. This standard may be prescribed by regulation or it may only be found by making a study of the consumer expectancy concerning a particular product. In any case, the standards prescribed by regulation are presumed to have been promulgated only after a thorough study has been made of consumer expectancy and should represent consumer expectancy.

Names of products have flexibility to the extent that it is necessary that they include reference to optional ingredients when such ingredients are used in the preparation of the food. For example, cereal may or may not be used in the preparation of frankfurters. Therefore, when cereal is used, the name of product includes a reference to the optional ingredient reading "Frankfurter, Cereal Added."

Names of products also have flexibility that permits adjusting them for use in connection with a limited variety of products. For example, the word "bacon" without qualification refers to the cured and smoked pork belly. When it is used in the name of product for cured and smoked pork jowl or cured and smoked pork shoulder plate, the appropriate names of

products are "Pork Jowl Bacon" and "Pork Shoulder Plate Bacon," respectively.

Names of products are misleading when applied to products for which the name is not applicable. For example, a purchaser would not expect the name "Pork Sausage" to appear on a label for a product prepared with or containing beef. Beef is not an optional or expected ingredient of pork sausage and, therefore, such labeling would misrepresent the product to the customer. Names are used only on products that come within the range of their understood meaning. Beyond that range it is no longer a name but a misnomer that is not representative of any known product and may, therefore, be misleading.

Products made in imitation of other products are labeled with the word "imitation" in type of uniform size and prominence and immediately thereafter the name of the food imitated. This form of labeling is distinguished from the few instances where the word "mock" has acquired popular acceptance with respect to a particular food as, for example, "Mock Turtle Soup."

A name of product should not be associated with terms suggestive of another product. Such terms may mislead the purchaser concerning the product so labeled. For example, the designation "Picnic Ham" is inappropriate for a pork shoulder picnic because the word "Ham" in the term "Picnic Ham" may lead the purchaser to expect that the product so labeled is, in fact, a pork ham.

The term "kosher" is misleading if used on a label for a meat or meat product which had not been prepared under rabbinical supervision.

Composition.—Even though the name of a product on its label is appropriate for the article, the label may be misleading concerning the ingredients used in the preparation of the product. This is because there is considerable latitude in a choice of ingredients for many products. Ingredient statements are used on labels to permit the purchaser to distinguish the kinds of products based on differences in ingredients used. Unless an ingredient statement is, in fact, representative of the ingredients that went into the particular product, that statement would be misleading and misrepresent the product to the consumer. An ingredient statement is considered to be misleading if it fails to list all of the ingredients that were used in substantial amounts, and if the listing does not show the names of the ingredients arranged in the order of predominance of the ingredients based on the amounts used in the preparation of the product. Obviously, an ingredient statement that carries a declaration of only some of the ingredients to the exclusion of others is misleading. Also, an ingredient statement that gives undue prominence to a minor ingredient may be misleading.

Illustrations appearing on labels are sometimes misleading concerning the composition of the product. Such illustrations are usually displayed for the purpose of suggesting to the purchaser a method for serving the product. Generally, such illustrations are obviously suggestions for serving in which case there should be no confusion on the part of the purchaser. Where the illustration that appears on a label as a suggestion for serving might be misleading, the phrase "Suggestion for Serving" or a comparable phrase is displayed prominently along with the illustration.

Quality.—It is sometimes difficult to distinguish between a superlative term that is displayed on a label that may mislead the purchaser concerning the quality of the product and a so-called innocent puff term that is presumed to be understood as such by the purchaser. In any case, terms such as "tops," best, premium, highest grade, and the like, can be qualified to limit their application to the products of a particular firm. This is accomplished by the simple device of preceding the superlative term with the possessive form of the firm name reading for, example, "Swift's Premium."

Meat grading terms can also be used on a label in such a way as to be misleading concerning the quality of the meat on which the label is used. The term "Choice," for example, has meaning with respect to a specific grade of meat for which there is a Federal specification. Were that term to be used in connection with meat that does not conform with the grade specification, the term would be misleading.

The term "tender" is a favorite for use on labels for meat and its products. Since tenderness is a relative quality in meat, the term "tender" has been considered to be misleading unless used on meat that had been subjected to a specific method of processing that does, in fact, impart to the meat a tender quality. For example, the word "tender" has been used on labels for cured and smoked pork cuts that had been subjected to a relatively high degree of heating for an extended period of time. This process does, in fact, impart tenderness to the meat. The term has also been used on labels for carcass beef of the higher grades that has been subjected to a controlled aging process that accomplishes a tender quality in the beef.

Terms that refer to certain qualities accomplished in the meat or meat product by particular methods of preparation are misleading on labels unless the appropriate method has, in fact, been employed. In this connection the word "roasted" is considered to be appropriate for use on pork cuts only if the pork had in fact been cooked by dry heat sufficient to attain an internal temperature of at least 160°F. in the product and to impart to its surface a rendered out appearance characteristic of a roasted product.

Illustrations on labels may also be misleading concerning the quality of products on which the labels are used. For example, an illustration of very lean bacon on a bacon wrapper would be misleading if the bacon in the package did not possess a comparable degree of leanness. An illustration of beef stew showing a large meat content would be misleading on a label for beef stew unless it contained at least as much beef as the illustration indicated. Another example is an illustration on a container of spaghetti with meat balls. The spaghetti with meat balls in the container should have at least as many meat balls as appear on the illustration and they should be of comparable size.

Quantity.—The statement of quantity of contents on a label would be misleading if it were not representative of the quantity of product covered by the label. Also, it may be misleading if it is stated in unaccustomed terms.

Variations incident to packing in accordance with good commercial practice are recognized as allowable. These variations should be reasonably constant for the same class of product. When the statement of the

quantity of contents expresses the minimum quantity, the purchaser is entitled to expect no variations below the stated minimum with the variations above the stated minimum in accordance with good commercial practice. When the statement expresses actual quantity, variations might be expected both above and below that quantity within the limits of good commercial practice. However, the average would be expected to be not less than the quantity stated.

Generally, in the absence of common consumer usage, the statement of the quantity of contents on the label for a container of liquid is in terms of liquid measure, while the statement is in terms of avoirdupois weight if the product is solid, semi-solid, viscous, or a mixture of solid and liquid.

Illustrations on labels may be misleading concerning quantity when the label illustrates a larger number of pieces than are in the container. Labels for canned tamales are a good example in this connection and should show no more tamales on their illustrations than are actually in the container.

Nutritive Value.—To label a food that it is health-giving or is enriched with vitamins or minerals is an implied promise to the consumer that it contains, in addition to the normal constituents of the food, sufficient additional nutritive values to substantially contribute to the nutritional welfare of persons eating the food in customary amounts. Most natural foods contain a wide variety of needed factors in sufficient amounts. It is highly probable that a diet of unenriched foods in reasonable variety would more nearly supply all needed factors, known and unknown, than a diet of enriched foods. The labeling of foods with "health" or "enriched" claims tends to confuse and mislead consumers through creating an exaggerated impression of the benefits to be derived from the consumption of such food.

However, if the customary process of manufacturing a staple food refines it so as to remove significant quantities of nutritive factors present in the natural product from which the food is made, and if the refined food is a suitable and efficient carrier of the factors so removed, some nutritionists advocate the restoration of such factors to the levels of the natural product as the most desirable basis of enrichment. To the extent that restoration serves to correct deficiencies of such factors, enrichment of the food is justified. Label declaration of such enrichment contains information concerning the quantity of added substance and the significance of the added factor in the diet of the consumer with respect to the amount of enriched food usually eaten.

Warranty.—Warranties are a common inclusion on labels as they are presumed to offer an added inducement to the prospective purchaser of a product. They may be misleading unless they offer something specifically and are clearly stated. The purchaser may be misled unless the warranty states what is being guaranteed and commits the guarantor to specific action if circumstances justify the purchaser to benefit from the warranty. An example of a good warranty is "Satisfaction Guaranteed or Your Money Refunded."

In contrast with a good warranty, the wording "Guaranteed Wholesome" is commonly seen on labels for food. This can mean nothing more than that the article is, in fact, the food identified by its label and is satisfactory to eat. This adds nothing to the usual rights that accrue to a

purchaser of food. A label bearing the words "Guaranteed Wholesome" may be misleading to the purchaser in that those words appear to offer something of additional value when, in fact, they do not.

Masking Inferiority. The color of uncured meat is recognized by the purchaser as being an indication of its freshness. He is accustomed to considering a bright red appearance of meat as indicating that it is freshly prepared. As the meat becomes stale this bright red color changes to a dark red, gray, or brownish red, especially that part of the meat exposed to the air. The addition of sulfite to meat that possesses the color normally associated by the purchaser with staleness restores the off color to bright red which the purchaser readily mistakes for the color of fresh meat. The sulfite radical replaces the oxygen in the metmyohemoglobin molecule to form a stable bright red sulfite of myohemoglobin.

A similar result could be accomplished by dyeing uncured meat with a bright red, coal-tar dye. For example, hamburger dyed in this manner will not develop an off color as it becomes stale and the purchaser relying on the bright red appearance of the product may be misled into buying the product on the mistaken idea that it is fresh. A convenient test for the presence of coal tar dye in hamburger is to place some of the product in water and the dye can be immediately demonstrated as it is dissolved out of the product by the water.

Preservatives may be used in a way that may mislead the purchaser of a food when they mask inferiority in the product. This is true when a preservative is used as a substitute for proper care in the handling and processing of a food.

Certain processes impart a characteristic appearance to meat as, for example, the familiar surface appearance of cured and smoked pork cuts. A ham possessing the appearance of a smoked ham would be expected by the purchaser to have acquired that appearance through a conventional process of smoking. The purchaser of a ham that looks like a smoked ham would be misled if, in fact, the ham had not been smoked but had been given the appearance of a smoked ham either by coloring it artificially or through the use of some device other than smoking.

Deceptive Containers.—The container of a food may be made or shaped in a way that may mislead the purchaser concerning the amount of food in the container. The container with a false bottom is a good example in this connection.

The purchaser of a food packed in a can is entitled to expect that the amount of food in the container is reasonably represented by the size of the can. Cans that are not filled to their capacity (slack fill) may be misleading in this connection. Similarly, the use of excessive amounts of packing medium may be misleading concerning the amount of food in the container. For example, the amount of brine used in packing frankfurters in a can should be limited to that which is necessary to fill the spaces between the frankfurters and between the frankfurters and the can that are inevitable when the frankfurters are packed snugly in the can according to good commercial practice.

Food may be displayed in a glass container in a way that may mislead the purchaser concerning the quality of the product in the container. For example, sauerkraut and frankfurters may be packed in a glass container in such a way that all the frankfurters will be visible through the glass. This may mislead the purchaser who would be justified in assuming that the proportion of sauerkraut to frankfurters that he sees as the article is displayed in the glass container is representative of the entire contents of the container. He would be justified in assuming that the frankfurters are uniformly distributed throughout the sauerkraut in the container.

Chapter

13

DETERIORATIVE CHANGES IN MEAT

ONLY those changes that occur in the animal tissue after death that affect its wholesomeness or fitness for food are classed under the heading of deteriorative changes. Meat is being constantly acted upon by its enzymes, bacteria and their enzymes, and the environment in which the meat is held. However, not all of the changes in meat that are influenced by these factors are deteriorative in the sense in which the term is used in this chapter. Changes in meat such as the reduction of glycogen to lactic acid and those brought about in connection with the controlled aging of meat, that are produced by enzymatic action, are beneficial. An example of a beneficial change produced by bacterial action is the tangy flavor produced in certain sausage products such as lebanon, thuringer, and in pork roll with the use of harmless bacterial starters of the acidophilus type.

Durability Factors.—A consideration of those factors that tend to give meat durability is a good introduction to the subject of deteriorative changes in meat.

Species.—Experience and some investigation has demonstrated that meats derived from the different species of food animals have different degrees of durability. Bull meat ranks highest in durability of meats. It and other beef are the most durable of meats, and mutton, veal, lamb, and pork follow in the order of lessened durability. Bull meat may show a high bacterial count without deterioration that can be detected organoleptically, whereas pork may show organoleptic changes under the same environmental conditions and with the same bacterial flora.

pH.—The durability of meats bears a direct relation to its acidity. Bacterial decomposition of meat has been demonstrated to progress more slowly in meat having a pH of approximately 6.0 or lower than in meat of a high pH. Investigations show that meats in cure which have an acidity lower than pH 6.0 provide an environment that inhibits the growth of bacteria that cause souring in meats of a higher pH. Likewise, comparisons have been made as to the keeping time before sliming of cured meats of different pH below the 6.0 level with the finding that the meats of the higher pH developed slime under the same environment sooner than those having a lower pH.

Environment.—*Temperature.*—At temperatures just above freezing, meat retains its fresh characteristics for a period of time sufficient to permit its distribution through the channels of trade to the consumer without significant deteriorative change. At temperatures low enough to freeze the meat to a solid condition throughout, it will keep without significant deteriorative change for periods up to six months.

Durability is also given to meat by heating it to temperatures sufficiently high to destroy its enzymes and the miscellaneous bacteria that inevitably are present. Since the cooking of meat causes it to pass through a wide range of temperatures, including temperatures that favor the growth of meat spoilage bacteria, the heating of the meat and the chilling of the meat after cooking should cause it to pass rapidly through the critical range of temperatures that favor these organisms if deteriorative changes in the meat are to be avoided. This critical temperature range lies between 60° and 115°F.

Humidity.—Not only must meat be held at temperatures which inhibit the growth of spoilage organisms, but the surface of the meat must be maintained as dry as possible to check the growth of organisms which have become adapted to the cold environment but need moisture to promote their growth. The humidity in the air of refrigrators is adjusted to avoid the development of a moist condition on the surface of the meat; and in the handling of the chilled meat in its distribution to the trade, care is taken to avoid exposing it to warm air from which moisture would be precipitated on the cold surface of the meat.

Cleanliness.—Meat that has been produced under clean conditions, with care being exercised to reduce its chance bacterial contamination to a minimum, has better keeping qualities than meat which has been produced in an unclean manner. This is recognized in manuals for meat canning where it has been found by experience that meats which are intended for canning must be kept scrupulously clean to assure satisfactory stabilizing results when certain methods of heat processing are used.

Ingredients.—*Salt.*—Since salt is so widely used in the preparation of many kinds of meat products, considerable investigation has been conducted to determine its effect on the stability of the product in which it is used. Most investigators have found that salt is not a bactericide in the concentrations in which it is used in meats but that it exercises a preservative effect through its inhibitory action on many species of bacteria. Many consider it to have the best preservative effect of any of the usual ingredients used in the curing of meats. Considerable stability is accomplished in meat cured with $3\frac{1}{2}$ per cent of salt.

Nitrate.—There are differences of opinion concerning the role played by nitrate in the stability given to meats by a process of curing. Recent investigations indicate that nitrate does not exercise any direct effect on bacteria themselves but appears to protect in some way the nitrogenous tissue against bacterial infection. The theory has been advanced that this is accomplished through an indirect effect in which hydroxylamine is formed during bacterial reduction of nitrates and this inactivates the catalase. This permits an accumulation of hydrogen peroxide which is extremely toxic for clostridia even in small concentrations.

Nitrite.—Earlier investigations gave rather inconclusive results concerning the bacteriostatic and bactericidal properties of nitrite. Recent work done in this connection identifies a definite bacteriostatic property of nitrite within certain acid ranges of pH. It has been demonstrated that .02 per cent of sodium nitrite, which is the amount of nitrite permitted to be used in the curing of meats, markedly inhibits and in certain instances

entirely prevents the growth of species of the following bacterial genera at pH 5.7 to 6.0: achromobacter, flavobacterium, pseudomonas, eschericheria, micrococcus, and aerobacter. The mechanism by which sodium nitrite inhibits bacterial growth has not been identified but it is known to act in a bacteriostatic capacity and probably even as a bactericide, depending on such conditions as concentration employed, pH, sensitivity of the bacteria cells, and length of exposure.

Acetic Acid.—Vinegar since early times has been added to food for its preservative value as well as for its flavoring qualities. The principal action of vinegar on bacteria is due to its acetic acid content, but it has been found to possess bacteriostatic and bactericidal properties in excess of that which can be attributed to pH alone. The inhibiting and lethal effect of acetic acid and salt mixtures on microorganisms is very pronounced. Pathogenic bacteria are killed rapidly in pickle composed of 3 per cent acetic acid and $3\frac{1}{2}$ per cent salt.

Smoke.—Experience has demonstrated that the smoking of meats reduces the total bacterial count to very low figures. This bactericidal action of the smoke is due to several of its constituents, principally creosote and formaldehyde vapors. Smoke constituents that have been absorbed by the meat during its exposure continue to exert a bactericidal action after the smoking is finished.

Not only does smoking reduce the number of surface bacteria, but it makes the fat of the smoked meat resistant to the development of rancidity. Investigations have shown that smoke enables surface fat of bacon to resist oxidation for a considerable period of time. Because of the reduction in bacterial numbers, its inhibitory effect on bacterial growth, and its increased resistance to rancidity development, smoked bacon has been found to keep sound about twice as long as unsmoked bacon under comparable conditions.

Antioxidants.—The durability of rendered animal fats is improved considerably by the addition of approved antioxidants (Page 218). The durability of rendered animal fats varies depending on the kind of raw materials used in the rendering process and the handling to which the rendered fat has been subjected. Lard, for example, which is produced by rendering uncured pork fat, has better stability than rendered pork fat prepared from cured pork fats. The refining process, especially when it includes treating the rendered fat with diatomaceous earth and activated carbon to improve its color, reduces the stability of the fat.

Bacterial Action on Protein.—The bacterial cell cannot assimilate the protein molecule. The cell is impermeable to it. The protein molecule must be broken down to peptones, polypeptides, and amino acids before the nitrogen content of the protein medium is available for use by the bacterial cell in its nitrogen metabolism. This digestion of the protein medium is achieved mainly by exoenzymes excreted into the medium by the bacterial cell. Since putrefactive species of bacteria must depend for their supply of food on the decomposition of protein, it is obviously necessary that some extra-cellular mechanism be present to disrupt the protein molecule into diffusible constituents assimilable by the bacterial cell. This ability to break down protein is not shared equally by all groups of bacteria.

Although the bacterial cell is impermeable to the protein molecule, it is known to excrete into the medium nitrogenous products of high molecular weight, both proteins and polypeptides. Some of the proteins possess enzymatic properties and constitute the exoenzymes referred to in the preceding paragraph, while others possess poisonous properties and are known as toxins. Some of the latter have now been demonstrated to act as enzymes and exert their toxic action on the host by means of enzymatic attack on its vital tissues. Other toxic proteins that are excreted by bacterial cells have not been identified as enzymes and owe their toxicity to other forms of action, the mechanism of which has not been fully explained.

Food Poisoning of Bacterial Origin.—There are four kinds of bacteria that produce food poisoning in humans. They are the staphylococci, salmonella, clostridium botulinum, and streptococci.

Staphylococci.—These organisms occur most commonly in connection with cases of food poisoning in this country. The organisms are widespread in nature but only a few of the *S. aureau* and the *S. albus* strains produce symptoms of food poisoning in man. Heating for thirty minutes at 143°F. destroys the staphylococci. The organisms grow well at temperatures from 70° to 105°F.; however, it requires four to eight hours of steady growth in rich food medium at 99°F. to produce enough toxin in food to cause symptoms of food poisoning in man. The toxin is an enterotoxin and it takes from two to four hours for the gastroenteritis symptoms of food poisoning to occur in man after consumption of the food. According to Jensen (1945), this type of food poisoning is responsible for over 90 per cent of actual unquestioned cases of food poisoning in this country.

Salmonella.—Food poisoning caused by these organisms runs second to that caused by the staphylococci in terms of frequency. It is known as the paratyphoid or salmonella type of food infection. The paratyphoid bacillus does not form a toxin but affects the digestive tract directly. The incubation period in this type of food poisoning may vary from ten to seventy-two hours or longer, depending on the number of bacteria ingested. This organism is also killed at pasteurizing temperatures of 143°F. for thirty minutes. The paratyphoid bacillus occurs universally in the intestinal contents of food animals. The exercise of care during the dressing of the carcass in the slaughtering department is necessary to avoid contamination of the meat with this organism that is inevitable if the contents of the digestive tract are permitted to come in contact with the meat while the abdominal viscera is being removed from the carcass or at any stage in the dressing operation or the viscera separating operations.

Botulism.—This is a food poisoning that is only rarely associated with the eating of meat. It is, however, an important type of food poisoning because of the severity of its symptoms. The organism responsible for this class of food poisoning is the anærobic bacterium *Clostridium botulinum* types A, B, C, D, and E. These bacteria will not grow in the presence of air or in an acid medium. They do not form the types of toxins which give rise to gastrointestinal upsets. The toxins in this case are neurotoxins which produce paralysis through action on the central nervous system.

The organism will not grow in the human body but produces its toxins in the foods which, when eaten, produces the characteristic symptoms.

When symptoms appear there are no known effective therapeutic measures that can be employed. Death results usually from respiratory failure. The mortality is high. The incubation period is twenty-four hours to four days after ingestion of the toxin. The toxin is usually destroyed by cooking for thirty seconds to five minutes at 176°F. The thermal death times of spores of C. botulinum range from .78 minute at 260°F. to 330 minutes at 212°F.

Streptococci.—Only a few rare instances of gastrointestinal upset have been reported as being caused by the *Streptococcus viridans*. These bacteria form no toxins and they attack the bowel direct. The incubation period after ingestion of the infected food is five to six hours. No fatalities have been reported in connection with this class of food poisoning. These bacteria are killed at pasteurizing temperatures.

Ptomaine Poisoning.—This term no longer has standing as a diagnosis for food poisoning. Because of its history of use in this connection, however, it is desirable to give it some attention if for no other reason than to explain its present status and give the reason for its fall from the respectable position it occupied for a great many years.

A ptomaine has been defined as a basic organic compound that is formed by the decomposition of nitrogenous matter. The term includes a wide variety of nitrogenous compounds resulting from the decomposition of protein. Some of these compounds are not particularly toxic and none are specific in the sense that bacterial toxins are. Bacteria which are in no way pathogenic may be capable of producing ptomaines. Others which are highly pathogenic may produce few or none of this class of organic compound. The expression "ptomaine poisoning" has been abandoned because it is a misnomer which does not identify an etiological factor associated with food poisoning. Food poisoning may arise from bacterial contamination of the food, from bacterial toxins retained in it, or from the presence of one or more of a large variety of deleterious chemical compounds. The expression "ptomaine poisoning" is not appropriate for any of these.

Decomposed meat, because of its objectionable taste and odor, is rarely eaten, and in any case the products of decomposition are not necessarily toxic. Contaminated meat, on the other hand, may contain pathogenic bacteria or bacterial toxins. Decomposed meat may, of course, also contain pathogenic bacteria or bacterial toxins. Clinical diagnosis of food poisoning, when it is suspected that the food is contaminated with certain bacteria or their toxins, should be supported by epidemiologic, bacteriologic, and toxicologic investigation. A diagnosis of "ptomaine poisoning" is no substitute for this.

Molds.—Molds growing on meats do not produce toxins and do not cause food poisoning. Thousands of different kinds of molds have been described. They have a great ability to become variants in response to a particular environment and develop resistance against adverse conditions. Their growth reactions are as different as their number of species. Some molds require darkness, others require light, and some are indifferent to

light or darkness. All molds do, however, require moisture for growth. Many species of mold are troublesome in refrigerated rooms and grow not only on the meats but also on the structural environment unless the humidity of the compartment is controlled. Proper air circulation is necessary to maintain the surface of the food, food containers, and environmental facilities in a dry condition to avoid mold growth.

Chemical Tests for Incipient Putrefaction of Meat.—Many chemical tests have been recommended and from time to time have been employed to detect incipient putrefaction of meats. None has replaced the practical evaluation of the fitness of meat by trained persons who rely on their reactions to taste, smell, appearance, and texture. None of the chemical tests is specific for detecting harmful deteriorative changes associated with infections of pathogenic bacteria or bacterial toxins. The principal incentive for the development of a chemical test to be used as an indication of fitness for food of meat or its products is the convenience of supporting an action of food seizure by testimony showing the results of the chemical test. Some food control officials have been inconvenienced when confronted with conflicting testimony concerning organoleptic observations involving seizures of spoiled meats.

There have been many chemical and physical tests employed in efforts to demonstrate spoilage: determination of amino acids; ninhydrin color reaction; amino nitrogen determinations; ammonia production; oxygen consumption tests (B. O. D.); nitrate reduction tests; methylene blue reduction tests and tests using other redox indicators; total nitrogen; non-protein nitrogen; total creatinine nitrogen; purine nitrogen, hydrogen sulphide tests; indol and skatol determinations; carbon dioxide tests; pH; iodine absorption; peroxidase test of Okolove; volatile acids; acid-alkali balance; redox potentials; Nessler's reagent; MgO test; electrical conductivity; surface tension; ultraviolet illumination—appearance and fluorescence; cryoscopic method; succinic acid determinations; Strohecker's permanganate test; etc. Jensen (1945) says that he has employed these many methods along with bacteriological examinations and has found no correlations useful either from a public health point of view or from the standpoint of specific defect in a product. The investigations of Hillig (1949), however, indicate that both the succinic acid content and the water-insoluble fatty acid content of fish products may afford a direct measure of the extent of deterioration. In any case, it would appear that conclusive testimony with respect to the fitness of any article of food should rely on the combined information obtained from chemical, bacteriological, and toxicological tests, and the organoleptic reactions of taste, smell, appearance, and texture experienced by an expert on food technology.

Insect Infestation.—The ham skipper (p. 142) infests cured pork products especially hams. It sometimes occurs in dried beef and salt pork. The characteristic injury to ham and other cured and smoked pork cuts consists of eating out areas along the large muscles. These affected areas may extend to the center of the meat close to the bone. Usually very fat meat such as bacon is not extensively injured since the insect prefers connective and muscular tissue.

Ham beetles (p. 143) evidence themselves on the product by their white

cocoons and are easily detected when the infestation is heavy. The appearance of these cocoons is often the first indication of the insect's presence. The adult beetles feed chiefly on the surface of the meat but the larvæ bore small holes into it, preferring to burrow in the fat parts.

The larder beetle (p. 144) attacks cured meats, dried meats, and cheese. Practically all injury to the product is caused by the larvæ which burrow into products such as hams, shoulders, and sides of bacon. Although the larvæ prefer the muscular parts they will burrow in the fatty portions. Dried smoked meats in neglected storage, when infested with this insect, may be reduced to powder by continued feeding of the larvæ.

Ham mites (p. 144) multiply very rapidly on the surface of infested cured meats. Often the molted skins are so abundant that they give a brownish powdery appearance to the surface of the infested product. They seldom materially damage the meat since they do not burrow into it, however, they produce an objectionable surface condition.

Usually the cured and dried meats that are found to be infested with insects and their larvæ or ham mites are not so extensively damaged as to require condemnation of the entire product. The infested portions are trimmed generously from the uninfested portion and condemned. Infested meat is not handled in uninfested rooms or areas for fear of spreading the infestation.

Crystals of Amino Acids.—Occasionally, white particles are observed in the lean portion of dry cured hams that have reached the age of a year or more. These particles are made up of bundles of crystals of tyrosin, histidine or another of the amino acids which are constituents of meat protein. There is always some breaking down of meat protein during the curing of meats. When the quantity of amino acids formed during the long process of dry curing is sufficiently large and conditions of storage are favorable, these separated amino acids crystallize and collect into small visible white particles that become scattered throughout the meat. This condition does not make the meat unwholesome, neither is it an indication of parasitic infestation which is sometimes suspected.

"Freezerburn."—When meat is stored in a frozen condition in an atmosphere of low relative humidity, there is a rapid drying of the exposed tissue. As the drying progresses the color of the surface tends to change to a pale amber and the consistency of the surface tissue becomes dry and shriveled. This condition is caused by the evaporation of ice crystals leaving behind tiny air pockets which tend to scatter the incident light and cause the tissue to appear lighter in color. This change in the dessicated surface tissue is irreversible and it persists after the meat is thawed. The same condition develops on the surface of frozen edible organs, such as livers, kidneys, hearts, and sweetbreads, packed in containers of absorbent material, such as paper-lined wooden boxes, in freezer storage of low relative humidity.

Discoloration of Heme Pigment.—The bright red heme pigments which occur as myohemoglobin in fresh meat, nitric-oxide myohemoglobin in uncooked cured meat, and nitric-oxide myohemochromogen in cooked cured meat are changed to gray and greenish pigments by the action of bacteria that have oxidizing capacities or which produce hydrogen sulphide. This

change is microbial, but it is not necessarily associated with putrefaction. However, the greenish discoloration constitutes an objectionable condition even though it is not a putrefactive change or the green pigments themselves are not considered to be toxic.

The oxidative changes which convert the bright red heme pigments into gray and greenish ones are held in check when there is no free access to oxygen. This availability of oxygen may be reduced by the growth of micro-organisms that produce reducing conditions in their environment. The oxidative change may also be held in check by the catalase normally present in uncooked meat and also by the catalase that is produced incident to the growth and development of many micro-organisms.

The role of hydrogen sulphide in the production of these green compounds is somewhat involved. Hydrogen sulphide reacts with reduced myohemoglobin to form a purplish compound. This compound rapidly oxidizes to form a greenish compound on exposure to oxygen. When myohemoglobin is treated with hydrogen sulphide in the presence of oxygen, the first reaction is so transitory as to be not apparent.

The oxidative changes that result in the formation of greenish compounds from the bright red heme pigments have been shown by indirect evidence to be the result of the action of hydrogen peroxide that is produced by the growth of certain types of micro-organisms. Micro-organisms that are salt-tolerant, capable of growing at relatively low temperatures, and are catalase-negative are associated with greenish discoloration of heme pigment when, as the result of their growth on the product, there is an accumulation of hydrogen peroxide.

Whether the greenish discoloration evidences itself as a surface condition, a green ring below the surface of a sausage product, or as a green core in the sausage, apparently depends on where the oxygen concentration presents the optimum condition for this development.

Spoilage.—Meat spoilage in terms of putrefactive change develops as a result of the growth of micro-organisms which attack the tissues incident to their metabolism of growth and development. The change in the meat develops by stages from a stale condition which has little but quality significance to offensive putrefaction.

Staleness in fresh meat is usually associated with a darkening of the lean surface attributed to the oxidation of the myohemoglobin to metmyohemoglobin. If the meat is stored in a reasonably dry environment, this dark surface will become rather parchment-like.

A slimy condition sometimes develops on the surface of processed meats as well as on fresh meats, due to heavy growth of micro-organisms under favorable conditions of moisture and temperature. The growth of micro-organisms that produce the condition of slime on the surface of meats may progress if conditions are favorable to a degree that the decomposition changes will render the meat unfit for food.

Microbial growth producing putrefactive changes also occurs deep in the tissues of large cuts of meat, such as beef rounds and pork hams. The condition known as "sour hip" that sometimes occurs around the femorotibial joint in large beef rounds results from the growth of organsims that

reaches putrefactive stages before the effects of refrigeration penetrate the heavy piece of meat to retard their growth.

So-called "sour spots" also occur along the femur in pork hams. These spots may develop as a result of one of two conditions. They may result as with the "sour hip" condition in beef rounds from the growth of spoilage organisms to the point where putrefactive changes are evident before the effects of refrigeration check the growth of the organism. The "sour spots" also occur deep in a cured ham as a result of a failure of the curing ingredients to penetrate all parts of the ham in time to check the growth of spoilage organisms.

A putrid condition sometimes develops in the bone marrow of hams and pork shoulders. The bone marrow of the femur may become putrid as a result of the growth of spoilage organisms before their growth is checked by refrigerating temperatures. This may also result because of delayed penetration of curing ingredients into the bone marrow.

Sometimes water pockets form in the bone marrow of the tibia of a cured hams and the fibula of cured pork shoulder picnics. The bone marrow is sometimes exposed by the cuts that sever the feet from the ham or shoulder. The water enters the bone marrow at the time the cured hams or cured pork shoulder cuts are soaked in water preparatory to smoking. The water dilutes the curing materials in the bone marrow and when the cured pork cuts are subjected to the smoking temperatures that favor the growth of micro-organisms, putrefaction of the bone marrow occurs.

Deterioration of Fat.—Odor Absorption.—Fatty tissue will absorb odors from its surroundings, and these odors may or not be objectionable depending on their character. The unpleasant "tainted" odor that develops during the spoilage of meat may be picked up by the fatty tissue of unspoiled meat that is stored in the same compartment with the spoiled meat. This unpleasant odor may carry over in the fat of the unspoiled meat even after cooking.

"Tank Water Sour."—Fat, rendered by injecting steam directly into it, is drawn off from the steam rendering tank with a high degree of care to avoid drawing off with the rendered fat any of the so-called tank water that separates from the fat during the rendering process. This tank water contains a high percentage of soluble proteins and residual animal tissue from which the fat was rendered. The tank water and residual animal tissue tend to settle out of the supernatant rendered fat. The rendered fat is drawn off into settling tanks where it is held in a melted condition to permit further settling out of all suspended tank water and particles of animal tissue.

Sometimes this drawing off of the rendered fat from the rendering tank and the settling of the fat is done carelessly and a substantial amount of the tank water remains suspended in the chilled rendered fat. The tank water is an ideal medium for bacterial growth which takes place under favorable conditions and decomposition of protein sets in. The presence of decomposed tank water in rendered fat produces a putrid condition in the product that is known as tank water sour.

If the decomposition of the tank water has not progressed too far or has not been of too long standing, the decomposed tank water can be removed

from the rendered fat by washing it thoroughly with clean, warm water.

If the putrid condition caused by the decomposition of the tank water is of long standing or extensive in degree the fat cannot be freed of the offensive condition because of the absorption of odors and probable chemical change in the fat itself.

Hydrolysis.—*Fat Tissue.*—Animal fats as they occur in the tissues are invariably accompanied by enzymes capable of hydrolyzing them, that is, these lipases are capable of decomposing fats into free fatty acids and glycerol. After death of the animal, the coordinating mechanisms of the cell break down and lipase attacks the fat. The rate of hydrolysis by the lipases of the fat is usually slow at low temperatures and, under more favorable conditions, their effect is frequently overshadowed by that of lipolytic enzymes produced by bacteria. Deterioration of fat tissue by the lipases of the tissues is of secondary importance in the storage of food.

Spoilage by micro-organisms occurs readily in fatty tissues and in the large variety of prepared foods containing fat. Numerous species of molds, yeasts, and bacteria are known to produce lipolytic enzymes capable of hydrolyzing fats. In some cases the enzyme remains confined within the cell of the micro-organism but usually it diffuses into the surrounding medium and there produces extensive decomposition. Microbial lipases from different sources are probably not identical, since they appear to vary to some extent in stability to heat and in the pH required for their optimum activity. Hydrolysis of fat can be produced under both ærobic and anærobic conditions.

Fat is not normally utilized so readily by micro-organisms as are carbohydrate and protein. Nevertheless, organisms have been successfully grown on artificial media containing only fat or fatty acid and mineral salts, the latter containing an ammonium salt or a nitrate as a source of nitrogen. Probably all organisms which utilize fat produce lipase so that the first stage in the metabolic process probably consists in decomposition of the glycerides into glycerol and fatty acids. Glycerol which is water-soluble and akin structurally to the sugars is partially utilized as energy, being oxidized to carbon dioxide and water. The mechanisms by which the free fatty acids are decomposed and utilized by micro-organisms are analogous to the processes of fat metabolism in the higher animals.

Rendered Fat.—The lipase that occurs naturally in the fat tissue is inactivated by the heat to which the tissue is subjected during the rendering process. Furthermore, since molds, yeasts, and bacteria require moisture, nitrogenous substances, and mineral salts for their metabolism in addition to a source of carbon, these organisms are absent from pure, dry rendered fat which cannot alone support their growth. Micro-organisms inoculated into such a medium, therefore, fail to produce any chemical change and the majority soon die. Organisms and spores of some types, however, remain dormant and viable for long periods.

The rendered fats of commerce are usually almost sterile when freshly prepared. Although they are a very poor medium for growth of micro-organisms they usually contain sufficient non-fatty impurities to support some growth if stored in the presence of water or at very high atmospheric humidities. Commercial lard containing 0.3 per cent of moisture inoculated

with various organisms showed growth in four weeks at 37°C., whereas dehydrated lard did not.

It is desirable that the fatty acid value of an edible rendered fat be low, because the temperature at which acrid vapors are given off when a fat is used for frying decreases quite rapidly with increase in free acid content. Even a small amount of free acid produces an appreciable reduction of the smoking temperature. The presence of free fatty acid also increases the rate of corrosion and darkening when cooking fats are heated in iron vessels.

Flavor.—It has long been the custom to associate deterioration in rendered fats with a high free-acid content, and the acid value has been and is still very widely used in the specifications for edible rendered fats. The usefulness of this characteristic in grading these fats undoubtedly depends in part on the fact that fats, which have been exposed to conditions leading to the production of considerable quantities of free acid, are usually also rancid. The converse, however, is by no means uniformly true in that fats, which have become rancid through atmospheric oxidation, do not necessarily show abnormally high acidities. It has been shown that free fatty acids prepared with adequate precautions against oxidative decomposition can be incorporated into neutral fats at concentrations up to 15 per cent without production of any unpleasant flavor. It has even been said that completely neutral oils or fats possess an insipid taste which is actually improved by the addition of very small amounts of free acids. This does not apply, however, to fats that contain appreciable quantities of acids of fewer than 14 carbon atoms such as milk fats and vegetable fats of the coconut palm kernel class which contain considerable proportions of volatile acids. These volatile acids possess an unpleasant rancid odor and taste and when liberated from their glycerides by the action of lipase confer these properties on the fat. The majority of food fats, however, contain no volatile acids and hydrolysis has little direct influence on their flavor.

Oxidation.—Deterioration of fat through oxidation is primarily due to the combination of the unsaturated constituent of the fat with oxygen to form addition compounds. These, then, decompose into secondary products some of which are responsible for the characteristic rancid odor and flavor of oxidized fats. Oxidation of fats proceeds in the heat-treated sterile material and in the absence of appreciable amounts of water indicating that the participation of biological agents is not necessary to the process. However, there are indications that the rate of development of rancidity in the fat of animal tissue can be greatly increased by biological oxidizing systems that are either present initially in the tissue or are produced by invading micro-organisms.

The oxidation of most fats proceeds with a more or less well-defined induction period during which absorption of oxygen and changes in the palatability either cannot be detected or are relatively small. This period frequently can be divided into two parts. The first may be prolonged with the oxidation proceeding at a slow and almost constant rate. During the second stage the velocity of the reaction increases in a logarithmic manner. The duration of the induction period is of practical importance since it determines, in many cases, the storage life of the fat or fat-contain-

ing product. Once the phase of rapid oxidation has set in, the characteristic rancid odor and flavor quickly appear.

The changes in odor and taste that are produced by oxidative rancidity vary considerably with the type of foodstuff and, to some extent, with the conditions under which rancidity has developed. When it has reached a sufficiently advanced stage, the odor frequently takes on a pungent, acrid quality. General rules cannot be given for the effect of the oxidation of fat on the flavor of the food containing it. However, the odor and flavor of the food are invariably objectionable and unpleasant.

Fat Tissue and Foods Containing Fat.—Various micro-organisms, particularly those that produce an indophenol oxidase, have been shown to accelerate the production of rancidity in fats, but it has not been established that this is due to the action of the indophenol oxidase. The increased rate of formation of peroxides and aldehydes observed when fat oxidizes in the presence of microbial lipoxidase indicates that the accelerated auto-oxidation probably follows the normal course. However, many micro-organisms by their metabolism set up reducing conditions. The main effect of the proliferation of a mixed flora on a fatty medium is therefore to inhibit oxidation of the fat. This effect may be due either to the production of reducing substances and enzymes or simply due to the quantity of available oxygen in the system being kept sufficiently low by the biological demand of the organisms to prevent oxidation of the fat. Microbial growth does not, however, invariably inhibit oxidation. Obviously, the precise effect gained depends on, among other factors, the susceptibility of the fat to oxidation, the free access of oxygen, and the numbers and types of organisms present.

Indications are that heat-labile organic oxidative catalysts (lipoxidases) may be fairly widely distributed in fatty animal tissue. The influence of these enzymes in the development of rancidity in the fat of animal tissue has not been examined in detail but it is believed that under suitable conditions lipoxidases do function as accelerators of oxidation. Various oxidizing enzymes have been demonstrated in muscle, and an indophenol oxidase has been detected in the fatty tissues of pork. This enzyme is readily inactivated by heat, exposure to a temperature of 60°C. for five minutes being sufficient to destroy most of its activity.

Atmospheric oxidation occurs spontaneously when any material containing unsaturated fat is exposed to the air. The rate of change varies considerably with the type of fat and with the condition of storage. Although spontaneous oxidation is a factor in producing deteriorative changes in fat tissue and foods containing fat, it is of considerable more importance with respect to rendered fat, a discussion of which follows under the heading "Rendered Fat."

Yellowing.—Closely connected with the process of oxidation of fat in animal tissue is the phenomenon of yellowing. When dry salt pork is allowed to hang at room temperature in an atmosphere sufficiently dry to prevent spoilage by micro-organisms, the exposed surface of the fat becomes discolored. This color ranges from a cream through yellow to a deep orange-yellow in very old samples. The production of this color is apparently linked in some way with oxidation, since fat which has turned

yellow always shows a high content of oxygen. Fat rendered from the fatty tissue of a hog carcass does not become yellow on oxidation. However, the characteristic yellow color can be produced in oxidized colorless lard by the addition of traces of alkali. It may be that the oxidized fat in the animal tissue is acted upon by ammonia as a product of protein decomposition in the tissue to produce the yellow color.

Rendered Fat.—Oxidation of dry rendered fat occurs spontaneously when exposed to the air through the action of oxygen on the unsaturated fat. A fat consists of a complex mixture of glycerides which in turn are built up from glycerol in combination with saturated and unsaturated fatty acids. Under ordinary conditions saturated fatty acids are stable in air. For example, palmitic and stearic acids have been recovered from Egyptian rock-tombs where they were found in what is believed to be the same proportion as when they were used probably as beef tallow in cosmetics buried thousands of years ago.

The amount of oxidative change necessary to make an edible fat rancid is very small. Fatty acids in general tend to become more reactive towards oxygen as the number of double bonds in the molecule increases. Linoleic acid, for example, oxidizes much more rapidly than oleic acid under the same conditions. The pronounced variation in stability toward oxidation shown by oils and fats from different sources is almost entirely due to the differences in the proportion and degree of unsaturation of the constituent fatty acids.

Susceptibility to oxidation is also influenced to some extent by the molecular structure. It is probable that the reactivity of a fat with multiple double bonds towards oxygen may vary in some degree with the proximity of the double bond in the chain to each other and to the carboxyl group. Hydrogenation of fats results in the elimination of the double bonds in the fatty acid portion of the molecule.

Influencing Factors.—The reaction of an autoxidizable substance with oxygen is usually characterized by a phase of very slow change which precedes rapid oxidation. This has been referred to as the induction period. In the case of fats, several factors influence the rate of oxidation and tend to shorten the induction period.

Temperature.—Like all chemical reactions the rate of oxidation of a fat exposed to the air is increased by raising the temperature and decreased by reducing it. The temperature of commercial cold storage reduces the rate of deterioration of the majority of food fats maintaining them in an edible condition for long periods. Oxidation of a given fat in the absence of light and of positive catalysts has a normal temperature coefficient, but the importance of temperature becomes progressively less as the intensity of illumination or the content of active metal increases.

Light.—Early investigators observed that exposure of fat to light had a marked effect in accelerating the development of rancidity. Under the influence of strong illumination, the induction period which precedes rapid oxidation becomes very much reduced and may disappear completely. It has been found that the exposure of fat to light even of relatively low intensity or for limited periods may have a very pronounced effect in accelerating the development of rancidity.

Peroxides and Ozone.—The active constituent of oxidized fats is usually assumed to be fat peroxide or hydro-peroxide. Peroxides other than those of fat can be equally effective and organic peracids are well known as accelerators of autoxidation.

Ozone attacks unsaturated fats with the formation of ozonides which subsequently decompose in a manner very similar to that of the peroxides produced in rancidity. Moreover, ozone is a powerful oxidizing agent and a catalyst for autoxidative reactions. The susceptibility of fats to the development of rancidity is greatly increased by exposure to ozone.

Metals.—Cases of oxidative deterioration in fat-containing materials of many kinds are frequently traced to contamination with copper and iron. The harmful effect of metals on fats is due to the acceleration of the normal process of oxidation. In the absence of oxygen, however, they are unable to produce rancidity. A trace of an active metal added to a fat may reduce and may almost destroy the induction period. Indications are that copper is the most active catalyst with tin and aluminum being quite inactive. Lead, iron, and zinc are intermediate in activity.

Canned Meats.—Unlike other meats which may be seen and handled to determine their condition, the fitness for food of meats hermetically sealed in a tin container can only be judged by the external appearance of the can. Deviations in appearance from what is referred to as a normal can are indications that the contents of the can may be unfit for food. Canned meats may become unsound because they were improperly heat processed at the time of canning or because of some fault in the container that developed during or following the canning operation.

A normal can is characterized by straight sides and slightly concave ends. Also, the food should entirely fill the inside of the container. Canned liquids, however, do not usually entirely fill the can, there being a small empty space in the head of the can. Deviations from normal in the outside appearance of the can are considered as raising suspicion concerning the fitness for food of the contents of the can. Many deviations can be explained and when there is a doubt as to the fitness for food of an entire lot of canned product it can be subjected to incubation temperatures and, following incubation, the results can be evaluated. In any case, only canned products that possess the outside characteristics of normal cans are distributed to the trade, since the purchaser has been taught to be suspicious of canned food when the container deviates from the normal, and will discriminate against such cans when purchases are made. It is important to encourage purchasers of canned goods to be discriminating so that a can of food, that has developed an unsound condition because of inadequate steam pressure cooking or of some fault in the can, will not endanger the health of a purchaser.

Leakers.—Even though the food has been thoroughly heat processed in a can that is not hermetically tight, spoilage organisms will enter the product through the opening in the can and the food in the container will decompose. Leaks in cans may result from incomplete closure through some fault of the lid or closing machine at the time the lid is clamped on the can. They also result from breaks in the tin by puncture with sharp objects due to careless handling of the canned product as it is packed and

distributed to the trade. Rust spots may perforate the tin to form leakers. Also occasionally, the partial cutting of a strip around the can to permit the opening of the can with the use of a key perforates the tin plate and a leaker results.

A leaker is detected by the soiled spot on the can where the gas and some juices are expelled from the can. This is associated with a looseness of the tin which becomes separated from the food in the can because the gases that have developed in the can have eliminated the slight negative pressure (vacuum) that holds the sides and ends of the can to the enclosed food in a normal canned product. The opening that produces the leak is sometimes difficult to locate especially when there is an incomplete closure which at first sight appears to be normal or when the opening is covered by the label.

Swellers.—The ends of the cans containing inadequately heat-processed food become distended as a result of gas that is produced in the can by the growth of spoilage organisms. Swellers also develop from leakers in those cases where there is a pinpoint leak which permits contamination of the food in the can but becomes closed, and as the gas is produced, it does not exhaust through the pinpoint hole until much pressure has been developed which, in the meantime, distends the ends of the can.

Overstuffed.—Cans that have been filled with an amount of food in excess of their capacity show distended ends. This gives the can an appearance similar to a sweller.

Since any deviation from the concave position of the can ends is considered as casting suspicion on the soundness of the contents of the can, overstuffed cans are not shipped to the trade. Overstuffed cans are emptied and their contents are examined for evidence of spoilage and, if found to be fit for food, the product is disposed of as being edible.

There is a class of swellers that is frequently confused with an overstuffed condition. This happens when the gas produced by decomposition of the contents in the can remains dispersed through the product giving it a spongy consistency. The gas forces the spongy product against the ends of the can producing a sweller, however, a dull sound characteristic of an overstuffed can is produced by tapping the end of the can. There is, therefore, no certain method by which the contents of the can that appears to be overstuffed might be definitely judged to be sound without opening the can for examination of the product.

Loose Tin.—Sometimes canned product which has been insufficiently exhausted (p. 261) before closure is heat processed. The purpose of exhausting the can before closure is to remove all air from the contents prior to sealing the lid on the can. This assures that when the canned product is cooled after heat processing, the ends of the can will conform to the mass of product in the can, and this is usually associated with a negative pressure in the sealed can. If the canned product has not been sufficiently exhausted before closure, the can will not be held tightly to the enclosed product and loose tin develops.

Cans showing loose tin are suspicious cans, because the condition may also result from the formation of a small amount of gas due to incipient decomposition of their contents. When lots of canned products showing

loose tin are incubated to ascertain the fitness for food of their contents, many of them will show distended can ends at the high incubation temperature. Determination, therefore, as to the fitness for food of the contents of this class of canned product is made after the temperature of the canned product cools to room temperature. If the distended condition of the cans disappears on cooling, their contents are judged to be fit for food. Even though it is found after incubation to be in sound condition, this class of canned product is discriminated against in the trade because the loose tin condition gives rise to suspicion concerning the fitness of the contents for food.

Contamination with Flood Water.—The contamination of canned product with flood water results in deteriorative changes because the exposed cans quickly rust at those points where the protective tin coating of the tin plate is broken during the canning process. Canned product that has been inundated by flood waters is examined carefully for weaknesses that develop in the can because of corrosive conditions. All those cans that show extensive rusting or corrosion are excluded from food channels. The paper labels are removed from the cans that are considered as being safe containers for food and the containers are washed in warm soapy water using a brush where necessary to remove rust or foreign material. The canned product is then immersed in a solution of sodium hypochlorite containing not less than 100 parts per million of available chlorine. The cans are then rinsed in clean, fresh water, dried thoroughly, relacquered if necessary, and relabeled.

Chapter

14

ORGANIZED MEAT HYGIENE CONTROL

MEAT Inspection is the term commonly used to designate the activity that applies the controls necessary to enforce the principles of meat hygiene at a meat packing plant. In fact, meat inspection is an essential element of meat hygiene because, generally, meat hygiene is not practiced in a meat packing plant without meat inspection control. That this inspection must be an official one to be effective has been recognized since before the time of Moses. In more recent times, President Theodore Roosevelt in his message of June 4, 1906 to the United States Senate and House of Representatives summed up the findings of extensive investigations of conditions in meat packing plants in large meat packing centers in the United States by saying, "A law is needed which will enable the inspectors of the General Government to inspect and supervise from the hoof to the can the preparation of meat food products." That year saw the enactment of the Federal Meat Inspection Law under which Federal meat inspection is still conducted.

Organizing a meat inspection agency requires a consideration of the objective of such an agency to identify the points at which controls will be applied. The objective is, of course, a clean, wholesome, disease-free meat supply that is not mislabeled. To gain this objective only healthy food animals should be converted to meat, diseased and otherwise unfit carcasses and parts of carcasses should be eliminated at the time of slaughter, the meat and its products should not be adulterated, diseased or otherwise unfit meat or products should be destroyed for food, the meat and its products should not be mislabeled, and environmental sanitation should be observed in the handling of the meat and its products. Meat inspection is organized in such a way as to apply its controls to accomplish these objectives. The inspectors, who are assigned to conduct examinations of food animals before they are slaughtered and their carcasses at the time they are slaughtered, must have the educational background that will enable them to identify and evaluate disease processes as they have a bearing on the fitness of the meat for food. Under the educational system as it is organized in the United States, courses of study that will provide this educational background are available only in college work leading to the degree of Doctor of Veterinary Medicine. Accordingly, in the United States, only veterinarians receive the kind of training that enables them to make final determinations with respect to the fitness of animals or their carcasses for the preparation of meat for human consumption. In organizing a large meat inspection group it has been found to be possible to use

laymen to assist veterinarians in the conduct of ante-mortem and post-mortem examinations. These laymen function under the immediate supervision of veterinarians. Laymen are also used to apply controls which relate to destruction for food of diseased or otherwise unfit meat or its products, adulteration, mislabeling, and environmental sanitation.

Assuming the organization of an effective meat inspection agency, its function depends on its basic powers to act. These are determined by the wording of the legislation that brings the agency into being and its jurisdiction depends on the governmental level at which the legislation was enacted. A model ordinance published by the American Veterinary Medical Association is given on page 333 of the Appendix. The Federal Meat Inspection Act which has served effectively as legislative background for organizing the Federal Meat Inspection Service is given on page 338 of the Appendix.

The jurisdiction of the meat inspection agency is its power or right to exercise authority within the scope of the legislation that sets up the agency. In this connection it is desirable to review briefly the organization of the Government of the United States. It is a combination of two Governments, national and state, with different spheres of action, each supreme and independent in its own sphere. Neither is vested with complete powers but the two operating together discharge all the proper functions of Government. The Constitution of the United States establishes and limits the powers of the national or Federal Government. The Federal system of Government thus established is necessarily a complicated one. It is useful to observe the distinction made by Justice Story in the case of Martin v. Hunter's Lessee decided in 1816 that "The Constitution of the United States was ordained not by the states in their sovereign capacities but emphatically as the preamble of the Constitution declares by 'the people of the United States.' . . . The Constitution was not, therefore, necessarily carved out of existing state sovereignties, ... On the other hand, it is perfectly clear that the state powers vested in the state governments by their respective constitutions remain unaltered and unimpaired except so far as they (powers) were granted to the Government of the United States. . . . The Government, then, of the United States can claim no powers which are not granted to it by the Constitution and the powers actually granted must be such as are especially given or given by necessary implication."

Federal legislation such as the Federal Meat Inspection Act of 1906 and the Food, Drug, and Cosmetic Act of 1938 are said to be an exercise by Congress of its interstate powers. The Congress, in Section 8 of the Constitution, is granted the power . . . "to regulate commerce with foreign nations and among the several States and with the Indian tribes." No more important power is conferred upon Congress by the Constitution. In the same Section, Congress is given the power . . . "to make all laws which will be necessary and proper for carrying into execution the foregoing powers, . . ."

State and Local Meat Inspection.—The meat inspection conducted by the State of California is a good example of a state and local organization. Meat inspection is mandatory in all California counties having a population

of 27,000 or more, and it is voluntary in the remaining counties. The State Department of Agriculture, through its Director, is charged with the responsibility of enforcing the Agricultural Code which includes provisions pertaining to meat inspection. The Division of Animal Industry of that Department administers the state meat inspection program as one of its several activities.

The Department is authorized by the Agricultural Code to approve and supervise municipal systems of meat inspection. This brings a municipal organization within the control of the state organization.

The organization of the meat inspection service of the State of California and its function are quite similar to the Federal Meat Inspection Service. Therefore, the description of the latter service which follows will serve also for the state organization. This, of course, does not apply to the controls exercised by the Federal Service over interstate shipments of meat, and exportations and importations of meats, which functions are peculiar to the Federal Service. The chart shown in figure 87 illustrates the meat inspection coverage in the State of California as applied by approved municipal inspection, state inspection, and Federal inspection.

Federal Meat Inspection.—Under the Federal Meat Inspection Act meat packers engaged in interstate commerce are required to operate under the supervision of Federal meat inspection. This results from the prohibition contained in the law against the interstate movement of meat unless it is U. S. inspected and passed and so marked. During 1950 there were approximately 1,000 federally inspected meat packing plants located in 365 cities and towns throughout the United States. These establishments were organized into 150 meat inspection stations, each headed by an Inspector in Charge. A few of these stations consisted of a single meat packing plant which because of its location did not lend itself to grouping with other establishments to form a larger station. The meat inspection stations range in size from those containing a single establishment to the large Chicago station containing 75 establishments. Figures 88 and 89 illustrate the volume of animals and product subject to Federal meat inspection.

The entire United States is divided into 7 areas with the stations in each area coming under the supervision of an Area Director. The 7 Area Directors along with the Chief of the Meat Inspection Service and his Assistants make up the organization's central office with headquarters in Washington, D. C.

The Washington office is divided into functioning sections, namely, the Special Projects Section, Trade Label Section, Inspection Procedures Section, Inspection Facilities Section, and the Laboratory Section. Each section formulates the policies within its particular area of responsibility and sees that the policy is applied uniformly throughout the country. This is accomplished through the personal contact maintained between the central office in Washington and each inspected establishment through the person of the Area Director who is co-responsible with the Inspector in Charge for the conduct of inspection.

Special Projects Section.—In this section is administered that part of the meat inspection program that relates to interstate movement of meat.

FIG. 87.—NUMBER OF ANIMALS SLAUGHTERED AT FEDERAL, STATE AND MUNICIPAL INSPECTED ESTABLISHMENTS IN 1948, AND NUMBER OF WHOLE CARCASSES CONDEMNED, ALSO ESTIMATED NUMBER OF ANIMALS SLAUGHTERED IN UNINSPECTED ESTABLISHMENTS AND ON FARMS, AND ESTIMATED TOTAL NUMBER OF ANIMALS SLAUGHTERED FOR THE STATE OF CALIFORNIA.

	Cattle		*Calves*		*Sheep*		*Swine*		*Goats*	
Inspection Departments	*Insp'd*	*Cond.*	*Insp'd*	*Cond.*	*Insp'd*	*Cond.*	*Insp'd*	*Cond.*	*Insp'd*	*Cond.*
Approved Municipal Inspection	12,361	21	2,606	44	142,452	411	22,099	52	208	—
State Inspection	265,653	1,349	197,830	639	304,475	1,320	179,538	390	1,697	26
Federal Inspection	1,170,308	4,015	417,016	7,419	1,716,519	11,257	1,528,140	4,769	469	3
TOTAL INSPECTED SLAUGHTER	1,448,322	5,385	617,452	8,102	2,163,446	12,988	1,729,777	5,211	2,374	29
*Estimated Uninspected Slaughter	29,000	—	49,000	-	80,000	—	89,000	-	—	—
ESTIMATED TOTAL	1,477,322	5,385	666,452	8,102	2,243,446	12,988	1,818,777	5,211	2,374	29

* Estimated uninspected slaughter includes the following:

Animals slaughtered on farms.

Animals slaughtered in uninspected slaughtering establishments located in counties of less than 28,000 population, in which compulsory meat inspection is not operative, and establishments operating under inspection exemption in other counties.

Fig. 88.—Ante-Mortem and Post-Mortem Inspections of Animals, Fiscal Year 1949.

Kind of Animal	*Ante-mortem inspection*				*Post-mortem inspection*		
	Passed	*Suspected*	*Condemned*	*Total*	*Passed*	*Condemned*	*Total*
Cattle	13,079,057	104,676	2,934	13,186,667	13,117,093	65,869	13,182,962
Calves	6,740,852	8,057	700	6,749,609	6,712,040	36,961	6,749,001
Sheep and lambs	13,889,035	5,640	825	13,895,500	13,820,077	74,234	13,894,311
Goats	262,057	7	—	262,064	260,806	1,258	262,064
Swine	48,941,872	121,356	2,073	49,065,301	48,956,231	106,432	49,062,663
Horses	307,520	266	8	307,794	305,916	1,869	307,785
Total	83,220,393	240,002	6,540	83,466,935	83,172,163	286,623	83,458,786

Fig. 89.—Meat and Meat Food Products Prepared and Processed under Supervision, Fiscal Year 1949.[1]

Product	*Quantity Pounds*
Placed in cure:	
Beef	120,720,960
Pork	3,213,574,534
Smoked and/or dried:	
Beef	55,987,753
Pork	1,990,532,562
Sausage:	
Fresh finished	242,795,972
Smoked and/or cooked	961,851,503
To be dried or semidried	118,735,086
Loaf, headcheese, chili con carne, jellied products, etc.	180,369,664
Cooked meat:	
Beef	29,799,827
Pork	552,006,645
Canned meat and meat food products:	
Beef	107,112,944
Pork	469,894,388
Sausage	83,493,448
Soup	402,232,097
All other	425,945,237
Bacon, sliced	679,605,650
Lard:	
Rendered	1,680,868,655
Refined	1,354,200,766
Rendered pork fat:	
Rendered	90,387,324
Refined	54,840,402
Oleo stock	89,275,032
Edible tallow	75,697,290
Compound containing animal fat	202,775,520
Oleomargarine containing animal fat	26,390,268
Miscellaneous	91,065,049
Horse meat products:	
Placed in cure	9,498,650
Chopped	25,274,771
Canned	43,108,666
Horse oil	3,042,481
Total	13,381,083,144

[1] The following quantities of meat and meat food products were condemned on reinspection and destroyed for food purposes on account of having become sour, tainted, rancid, unclean, or otherwise unfit for human food: Beef, 2,784,746 pounds; pork, 4,701,794 pounds; mutton, 80,567 pounds; veal, 57,102 pounds; goat meat, 3,083 pounds; horse meat, 141,786 pounds; Total, 7,769,078 pounds.

importations, exportations, farmer and retail dealer exemptions, and violations of the Meat Inspection Act.

Through a system of certifications, responsibility is established in connection with the interstate movement of meat. It is provided by the meat inspection regulations that the interstate carrier of meat shall request and the shipper of such meat shall furnish a certification in the form prescribed by the regulations. The certificate identifies the meat being offered for shipment in interstate commerce and states that it conforms with the law.

The control of importations of meat is calculated to assure that the meats that are brought into the United States from foreign lands have been subjected to the same controls as meats in the United States that are subject to Federal legislation. A country which desires to send its meats to the United States requests that its sytem of inspection be accepted as being comparable to that maintained by Federal meat inspection in the United States and asks that its certificates be accepted by the Federal Meat Inspection Service as evidence of such inspection. Investigations are then made to ascertain whether the inspection of the foreign country is, in fact, comparable to that maintained in the United States. If it is found that the foreign inspection is a satisfactory one, arrangements are made to provide a system of certification whereby each arrival at a port in the United States of a shipment of meat from that foreign country will be identified as to its inspectional background. If upon inspection by the Federal Meat Inspection Service the meat is found to be sound and wholesome, free from adulteration, and properly labeled, it is permitted to be brought into the United States.

Exportations of meat from the United Sattes are covered by certificates of inspection that are recognized in all foreign countries. A vessel is not permitted to clear a port in the United States with a consignment of meat for a foreign country unless the meat is identified by export stamps or an export certificate evidencing the fact that it had been prepared under Federal meat inspection. One of the accomplishments of Federal meat inspection and its system of export certification is to assure free movement of American meats in foreign trade.

The Federal Meat Inspection Act provides that farmers and retail dealers need not have their products inspected. However, they are subject to the other requirements of the law which prohibit interstate movement of unfit, adulterated, or mislabeled meats. A system of licensing has been worked out to maintain the necessary control over retail establishments that take advantage of the exemption provision contained in the law. This makes effective the basic elements of the statute at retail establishments engaged in interstate commerce.

The Special Projects Section uses the services of meat law investigators who are strategically located throughout the country to detect and investigate violations and suspected violations of the law. When a violation of the law has been committed, a case is prepared by this section and appropriate steps are taken for the prosecution of the offender.

Trade Label Section.—The inspected meat packer is permitted to use only those labels and markings that have been previously approved by

the Meat Inspection Service. This section performs the label review function which assures that each label contains the required labeling information, that it contains no misleading feature, and that it is appropriate for the product on which it is intended to be used.

It is through the activities of this section in limiting the use of a label to the product for which it is applicable that standards of composition for the many processed meat food products are promulgated and enforced. When a label is presented for approval, assuming that it contains all the required labeling information and that it bears no misleading feature, the name of product on the label is appropriate only for a particular food. When the meat packer is informed that the label is approved for that particular food, he is informed concerning the requirements for its composition. Also, the inspector is informed so that he can supervise the preparation of the product to make certain that it conforms with the standard.

Inspection Procedures Section.—This section is responsible to see that the procedure used by each inspector in his inspection routine at a meat packing plant is adequate for the protection of the public meat supply and, at the same time, is that minimum which is necessary to accomplish results.

New and changed processes and methods are constantly being proposed for use by the inspected meat packer. These are evaluated in terms of the adequacy of current inspection procedures to meet the changed situation. Also, it is necessary to review existing practices to make certain that the necessary controls are being applied at all times.

Not only must procedures be identified that are necessary to accomplish the desired results, but these procedures are applied uniformly by all of the inspectors in all of the inspected meat packing plants throughout the country. This requires constant attention and review because of two very significant variables, one the human element and the other differences in plant facilities as between establishments.

Inspection Facilities Section.—All those factors relating to environmental sanitation and facilities for inspection are the responsibility of this section. An applicant for the inspection is required to present to this section for its review and approval complete plans of his plant, equipment, and facilities. These plans are reviewed to determine whether the plant in which it is requested that inspection be maintained will provide a satisfactory environment for the inspection and handling of product. When the plant is found to be acceptable the plan is approved and the inspection is inaugurated.

Changes and additions to existing plants in which inspection is being currently maintained are also reviewed by this section. Such changes and additions are made only after the plans for their installation have been approved. The installation is required to be made in accordance with the approved plan.

Specifications for equipment and plant layout are drawn up by this section for use as guides by managements of inspected plants and applicants for the inspection. Investigations are made of materials currently in use and of new materials to ascertain their suitability for food contacting surfaces and structural environment that have a bearing on food sanitation.

Laboratory Section.—This consists of 7 field laboratories and a central office where the chief of the section is located. The 7 field laboratories are located strategically throughout the United States and are available to inspectors for their use as part of their inspection procedure. The central office is located in Washington, D. C., and the chief of the section is a member of the meat inspection staff. He supervises the work of the field laboratories. His office reviews analytical methods currently in use to determine their suitability. Also, new analytical methods are developed to meet changing requirements. Investigations are also conducted to determine the suitability from the point of view of wholesomeness of new ingredients that are proposed from time to time to be used in the preparation of meat food products.

* * * *

The effectiveness of the Federal meat inspection program lies in its use of the authority that is vested in its inspectors to act summarily in an inspected packing plant to destroy diseased or otherwise unfit product, correct an unsanitary condition, prevent adulteration of product, and prevent mislabeling.

After the meat bearing the marks of the inspection is shipped from a federally inspected establishment, it passes out of the direct control of the Meat Inspection Service and into the domain of local and state control and, in the Federal field, the control of the Food and Drug Administration. Each agency acts with a high degree of autonomy in its particular jurisdiction but there is a close working relationship between the various groups that have meat control responsibility.

The following quotation from a memorandum by Dr. L. D. Elliott, Acting Commissioner of Food and Drugs, Food and Drug Administration, is not only a good example or cooperative relations between that Administration and the Federal Meat Inspection Service but also serves to illustrate how the activities of the two agencies are coordinated.

"Section 902(b) of our law (The Food, Drug and Cosmetic Act of 1938) exempts meats and meat-food products from its provisions to the extent of the application of the Meat Inspection Act. Since the Meat Inspection Act contains no seizure provisions (outside inspected establishments), meats and meat-food products which are violative of our Act are therefore not exempt from seizure under our law. The Meat Inspection Service has in the past and will continue to welcome seizure actions by us against violative meat-food products found in interstate channels in the interest of the protection of the public in view of their own inability to take such action (outside inspected establishments). If a Federal meat inspector, or other representative of that agency stationed anywhere in the field, encounters a consignment of a meat product which he finds to be or has reason to suspect of being unsound and unwholesome, he has no authority under his law to institute action against it but he has the responsibility of calling the consignment to the attention of the nearest available regulatory food official who does have the authority to seize it or to put some restraining order on it to prevent its distribution to the consuming public. If the inspector is located in one of our station cities or where one of our inspectors

may be nearby, he calls it to the attention of our station or inspector, and in so doing he is saying in effect that the Meat Inspection Service is turning the consignment over to the Food and Drug Administration for whatever action it deems appropriate under its seizure provisions. If the Federal meat inspector happens to be located at a place remote from any of our people but near a state official, he would call the attention of the state official to a violative consignment for whatever action the state official might desire to take under his law.

"If an obviously violative interstate shipment of meat-food product is located or detected by our own people rather than by a Federal meat inspector, the Meat Inspection Service has no objection to our proceeding with action under our law, but expects us to notify the nearest Federal meat inspection office of the facts not only as a matter of maintaining proper cooperative contact, but to enable the Meat Inspection Service to institute a prompt investigation at the establishment where the consignment originated to locate and correct conditions that might be responsible for the deterioration of the product.

"Sometimes the consignee of a shipment, upon suspecting it of being unsound or otherwise unfit for food, desires to ship it back to the inspected establishment where it originated. However, the Meat Inspection Act, according to my understanding, makes both the shipper and the carrier amenable to the penal provisions for the interstate shipment of an unsound meat-food product. Therefore, to take care of the situation where a consignee desires to ship the suspected consignment back to the establishment where the Meat Inspection Service, can reassume jurisdiction, the Meat Inspection Service is authorized to issue a permit to the reshipper and carrier, which in effect exempts them from the penal provisions of the Act on that particular reshipment. The issuance of such a permit is not to be interpreted as a desire on the part of the Meat Inspection Service that the Food and Drug Administration refrain from seizure of the goods in the hands of the consignee. As a matter of fact, since the Meat Inspection Service has no jurisdiction over the goods shipped under such permit until they reach the inspected establishment, there is nothing to prevent the diversion of the consignment en route.

"The Meat Inspection Service is perfectly willing for us to proceed with any contemplated seizure so that if the goods are subsequently taken down under bond for reshipment to the inspected establishment for segregation and destruction of the unfit material, there will be the additional safeguard of a bond."

Federal Food and Drug Administration.—To discharge its technical, administrative, and regulatory responsibilities, the personnel of the Food and Drug Administration includes chemists, bacteriologists, physicians, veterinarians, microscopists, pharmacologists, inspectors, administrative officers, and other specialists. These are divided into a field service organized into 16 districts and staffed by more than 600 people, and the central administrative office in Washington, D. C., where there are also extensive laboratory facilities.

The district headquarters are manned by inspectors and analysts working under the direction of a district chief. This organization is sufficiently

flexible to permit shifting its personnel from routine law enforcement to a mobilized effort which is necessary from time to time to cope with emergencies. Such a shift may become necessary because of the contamination and spoilage of large quantities of foods by flood waters or in connection with the discovery that a dangerous food has become widely distributed. Each district is responsible to see that the laws enforced by the Food and Drug Administration are compiled with by the manufacturers, dealers, and importers who trade within the specified territory making up the district.

The Food Division is one of several subject matter divisions in the Administration's central office and it is the leader in the development of scientific methods of food law enforcement. It is the repository of existing technical knowledge and a workshop for improving and developing methods of analysis for establishing definite proof of violations. The Division acts as a reviewing laboratory in cases developed under the food provisions of the several acts enforced by the Administration and furnishes expert witnesses for court cases. It prepares project plans on foods and initiates and executes the investigational work which is an essential preliminary to regulatory activity. In such investigations the Food Division, with the assistance of the field force, ascertains current trade practices through the medium of factory inspections; prepares and subsequently analyzes experimental packs of food products; determines the composition of numerous market samples; and acquires information concerning consumer understanding of the composition of foods and various trade practices.

To promote honesty and fair dealing in the interest of consumers authority is granted by the Food, Drug and Cosmetic Act for the formulation and issuance of regulations establishing for any food a reasonable definition and standard of (1) identity, (2) quality, and (3) fill of container. Special investigations are conducted by the Food Division in connection with the formulation of such food standards.

Cooperation with State and Local Officials.—For the purpose of developing and maintaining active cooperation with all State and local officials enforcing State and local food and drug laws, there is a Division of State Cooperation. Through the program of mutual assistance sponsored by this Division it is possible for State and Federal officials to check adulteration and misbranding within their respective jurisdictions more effectively. There is extensive interchange of information among all regulatory officials. Data for the solution of technical and administrative problems are made available upon request. Frequent area conferences, continuous contact between field forces of the Food and Drug Administration and State and local officials, and national and sectional associations of regulatory personnel also stimulate cooperation. Responsible State officials are commissioned by the Federal agency to conduct examinations and investigations as its agents in the enforcement of the Federal Food, Drug and Cosmetic Act.

Since enforcement of the Food, Drug and Cosmetic Act with complete coverage is impossible, selective enforcement is necessary. Furthermore, from the consumer viewpoint, not all types of violations are of equal importance. Coupled with this segregation of types of violations is a segregation of products and manufacturers most commonly found to

violate the law. This is done by obtaining as nearly complete knowledge as possible of the practices of every branch of the food industry. By this means the detection of probable violations and the identification of those manufacturers whose operations are apt to require supervision are possible.

Experience has demonstrated that in the case of certain products adulteration or misbranding is practically never found. The Administration is thus enabled to concentrate its working forces and its funds largely upon those products usually in violation of the law. Once violations of the law are encountered, simultaneous and uniform action against them is instituted throughout the country by the various food and drug districts. This plan of regulatory action based upon the application of these principles of planning to apply controls to a group of related products is termed a project plan.

Methods of Enforcement.—In appropriate instances the institution of formal legal action may be preceded by a public hearing at which interested persons may participate in the determination of an administrative policy. In line with the emphasis upon educational effort as part of the program of enforcement, the Act allows resort to a suitable written notice of warning when it is thought to be warranted by the public interest as an alternative to punitive action to control minor violations. Apart from this, the Food and Drug Administration is constantly informing the industries subject to the Act of its requirements with a view to keeping actual violations at a minimum. This is done by means of correspondence and various types of publicity releases informing manufacturers and shippers of the legal requirements imposed upon them. In addition to advisory legal interpretations, such information may also take the form of valuable technical data, the utilization of which by those affected will permit a ready compliance with the Act.

In addition to informal methods of enforcement, the Food and Drug Administration has its choice of several formal legal actions. One of these is actual seizure of the offending products, known legally as a libel for condemnation proceeding. In such a proceeding the articles in question are seized to prevent them from reaching the ultimate consumer. The seizure follows the request by the Food and Drug Administration of a United States Attorney that he file a libel (a descriptive legal document) with the proper Federal Court. Acting upon a court warrant issued pursuant to the filing of a libel, a United States marshal (usually accompanied by a Food and Drug Administration inspector) seizes the articles. They are then within the jurisdiction of the court. The party who has an interest in the seized articles, known technically as the claimant, may fail to make an appearance before the court, in which event the case is disposed of on default. Or he may appear but agree with the contentions of the Administration in the libel, in which event a consent decree would issue. When the claimant contests the seizure, the question of whether or not the articles are in violation of the Act is tried in Federal Court.

Products which have been seized and condemned are not necessarily destroyed, but they may not be disposed of contrary to the provisions of the Food, Drug and Cosmetic Act or the laws of any State or territory in which the disposition happens to take place. The court may order the

offending products destroyed if they cannot be reclaimed in any way, which is true of decomposed foods and foods containing poisonous substances. But frequently adequate reworking (by which there can be affected the removal of excess moisture from butter), sorting, (often possible with canned goods not all of which have been damaged), or cleaning (appropriate for the separation of excessive débris from nuts), will correct the adulteration. In the same way, relabeling (for such violations as an incorrect statement of net weight) will often render misbranded articles entirely legal and suitable for distribution. Under these circumstances the articles may be released to their owner under bond for reconditioning under governmental supervision.

When an adverse decision against the claimant has been rendered, or when the owner has abandoned goods which have been seized, the court, as alternatives to destruction, may either give them outright to charity, or direct their sale by the appropriate United States marshal after ordering him first to eliminate the adulteration or misbranding involved. The proceeds of the sale, less the legal costs incurred, are sent to the United States Treasury.

A second penalty is criminal prosecution of the person or firm responsible for the violations of the provisions of the Act. For the commission of any of the deeds prohibited by law, a maximum fine of $1,000 and imprisonment not in excess of one year may be imposed. Where the violation is done with intent to defraud or mislead, or where it is a second offense, the maximum fine becomes $10,000 and maximum imprisonment three years.

The third method of enforcement is through the use of the injunction. In some instances, seizure and criminal prosecution are unsatisfactory means of enforcement especially where a person or firm indulges in repeated and frequent violations. Congress has therefore authorized the Administration to apply to Federal District Courts for restraining orders (injunctions) which, in effect, deny the channels of interstate commerce to adulterated or misbranded foods.

Selection of Appropriate Penalty.—Each of the above penalties is sought by the Food and Drug Administration under well-defined circumstances. Seizure is employed against products containing ingredients harmful to health and those marred by filth and decomposition. Seizure is used also to prevent the distribution of products containing grossly false or misleading claims and those adulterated or misbranded so as to seriously demoralize legitimate trade practices. The Food, Drug and Cosmetic Act permits more than one libel proceeding to be instituted simultaneously—so-called multiple seizure—when the evidence indicates probable cause that the misbranding is fraudulent, or dangerous to the health, or in a material respect misleading, to the injury or damage of the consumer. The object of both single and multiple seizures is to prevent adulterated or misbranded products from reaching and harming the ultimate consumer. This is achieved by removing the offending articles from the market. Consequently, seizures occur wherever the consignment happens to be found.

Criminal prosecution is directed against the person or firm responsible for the offense and is always confined to the jurisdiction where the defendant has his place of business. It is necessarily a slower remedy because the

Act requires that a potential defendant be first given appropriate notice and an opportunity to present his oral or written views on the matter, after which proper pleadings must be drawn up, affidavits of analyst and other witnesses secured, and all forwarded through the Department of Justice to the United States Attorney in whose jurisdiction the defendant has his business. The case must then await its turn on the calendar. The trial itself is subject to the legal restrictions necessarily prevailing in criminal procedure, an important one of which requires exacting evidence to prove guilt. The result is that though criminal prosecution may legally be based upon the same consignment which led to the institution of seizure proceedings, such prosecution is often precluded where seizure action can be maintained. This is true, for example, of perishable foods that are subject to seizure because decomposition occurred after shipment. In such cases no criminal responsibility ordinarily rests upon the manufacturer.

This difference in the required degree of proof has brought about the adoption by the Administration of the practice of consolidating a number of shipments by one firm, each of which may have been the subject of a seizure, into one prosecution action. This individual recital enables a more effective presentation to the courts of the continuing character of the illegal practices of the defendant. This, together with factors already noted, accounts for the larger number or seizure actions instituted by the Administration. It does not mean that no recourse is had to criminal prosecution when the facts of even a single shipment warrant such action.

The Administration publishes from time to time reports summarizing all judgments, decrees, and court orders which have been rendered under the Act. These periodical reports are known as notices of judgment.

APPENDIX

STANDARD METHODS FOR THE EXAMINATION OF WATER AND SEWAGE

Prepared, Approved, and Published Jointly by the American Public Health Association and the American Water Works Association

SAMPLES

A. Collection

Samples for bacterial analysis shall be collected in bottles which have been cleansed with great care, rinsed in clean water, and sterilized.

Great care must be exercised to have the samples representative of the water to be tested and to see that no contamination occurs at the time of filling the bottles or prior to examination. Ample air spaces should be left between the stopper and the level of the water sample in the bottle in order to facilitate mixing of the sample by shaking, preparatory to examination.

B. Storage and Transportation

Because of the rapid and often extensive changes which may take place in the bacterial flora of bottled samples when stored even at temperatures as low as 10° C., it is urged, as a matter of importance, that all samples be examined as promptly as possible after collection.

The time allowed for storage or transportation of a bacterial sample between the filling of the sample bottle and the beginning of the analysis should not be more than six hours for impure waters and not more than twelve hours for relatively pure waters. During the period of storage, the temperature shall be kept between 6° and 10° C. Any deviation from the above limits shall be so stated in making reports.

DILUTIONS

Dilution bottles shall be sterilized in the autoclave at 15 pounds (121° C.) for fifteen minutes after the pressure reaches 15 pounds.

Dilution bottles or tubes shall be filled with the proper amount of water so that after sterilization they shall contain 9 or 99 ml., as desired, with a tolerance of 2 per cent. The exact amount of water to be placed in the bottles may be determined only by experiment with the particular autoclave in use. If desired, the 9 ml. dilution may be measured from a flask of sterile water with a sterile pipette.

The water used for dilution shall be tap water. Distilled water shall not be used.

The sample bottle shall be shaken vigorously 25 times and 1 ml. withdrawn and added to the proper dilution bottle or tube as required. Each dilution bottle or tube after the addition of the 1 ml. of the sample shall be shaken vigorously 25 times before a second dilution is made from it, or before a portion is removed.

PLATING

Plating shall be completed within twenty minutes after dilutions are made. One-half ml. or 1 ml. of the sample or dilution shall be used for plating and shall be placed in the Petri dish first. Ten ml. of liquefied medium (nutrient agar, tryp-

tone glucose extract agar, or gelatin) at a temperature of about 42° C. shall be added to the water in the Petri dish.

The cover of the Petri dish shall be lifted just enough for the introduction of either the pipette or culture medium and the lips of all test tubes or flasks used for pouring the medium shall be flamed. The medium and sample in the Petri dish shall be thoroughly mixed and uniformly spread over the bottom of the Petri dish by tilting and rotating the dish. All plates shall be solidified as rapidly as possible after pouring and placed immediately in the appropriate incubator.

INCUBATION

Gelatin plates shall be incubated for 48 ± 3 hours at 19° to 21° C. in a dark, well-ventilated incubator in an atmosphere practically saturated with moisture.

Agar plates may be used for counts made either at 19° to 21° C. or 35° to 37° C. The time for incubation at the lower temperature shall be 48 ± 3 hours and that at the higher temperature, 24 ± 2 hours. The incubators shall be dark, well ventilated and the atmosphere shall be practically saturated with moisture. Glass covered plates shall be inverted in the incubator. Any deviation from the above described method shall be stated in making reports. Plates shall not be closely packed.

When reporting the results of water examination the medium used for the total, count should be stated, *i. e.*, whether gelatin or agar, and the temperature of incubation given.

COUNTING

In preparing plates such amounts of the water under examination shall be planted as will give from 30 to 300 colonies on a plate and the aim should be always to have at least two plates giving colonies between these limits.

Where it is possible to obtain plates showing density of colonies within these limits, only such plates should be considered in recording results, except when the same amount of water has been planted in two or more plates, of which one gives colonies within these limits, while others give less than 30 or more than 300. In such case, the result recorded should be the average of all the plates planted with this amount of water.

Ordinarily, it is not desirable to plant more than 1 ml. of water in a plate; therefore, when the total number of colonies developing from 1 ml. is less than 30, it is obviously necessary to record the result as observed, disregarding the general rule given above.

Counting shall be done with a lens giving a magnification of 1½ diameters. An approved counting aid, known as the Quebec Colony Counter is recommended. In order to insure uniformity of counting conditions, illumination equivalent to that provided by the Quebec Colony Counter shall be employed.

In order to avoid fictitious accuracy and yet express the numerical results by a method consistent with the precision of the technique employed, the recorded number of bacteria per ml. shall include not more than two significant figures. For example, a count of 142 is recorded as 140, and a count of 145 is recorded as 150; whereas a count of 35 is recorded as such.

The gelatin count at 19° to 21° C. and the agar counts at 19° to 21° C. and at 35° to 37° C. shall be designated "standard gelatin plate count," "20° C. standard agar plate count," and "37° C. standard agar plate count," respectively.

TESTS FOR THE PRESENCE OF MEMBERS OF THE COLIFORM GROUP

A. Introduction and Definitions

1. Definition

It is recommended that the coliform group be considered to include all aerobic and facultative anaerobic Gram-negative non-spore-forming bacilli which ferment lactose with gas formation.

The "coliform group" as defined above is equivalent to the "B. coli group" as used in all editions of Standard Methods for the Examination of Water and Sewage prior to the sixth edition, and to the "coli-aerogenes group" of later editions.

2. The Standard Tests

The standard tests for the coliform group shall be either the Presumptive Test, or the Confirmed Test.

In these standard tests lauryl sulfate tryptose broth may be substituted for lactose broth in the examination of all water except final filtered, treated, and filtered-treated waters. It may be substituted for lactose broth also in the examination of final filtered, treated and filtered-treated waters provided the laboratory worker has amply demonstrated by correlation of positive completed tests (isolations of coliform organisms) secured through the use of lauryl sulfate tryptose broth with those secured through the use of lactose broth, in the examination of such waters, that the substitution results in no reduction from the density of coliform organisms indicated by the standard procedure using lactose broth.

3. Presumptive Test

The formation of gas in a standard lactose broth fermentation tube at any time within 24 ± 2 hours with incubation at 35° to 37° C. is presumptive evidence of the presence of coliform organisms, since the majority of the bacilli which give such a reaction belong to the group.

4. Confirmed Test

The formation of gas at any time within 48 ± 3 hours with incubation at 35° to 37° C. in a fermentation tube containing brilliant green lactose bile broth which has been seeded from a lactose broth fermentation tube in which gas has formed, or the appearance of aerobic lactose-splitting, typical Escherichia coli colonies on a specified solid confirmatory medium streaked from a lactose fermentation tube in which gas has formed, confirms the presumption that gas formation in the fermentation tube was due to the presence of members of the coliform group. (If only colonies not typical of Escherichia coli have developed on the solid medium, the Completed Test is to be applied.)

5. Completed Test

To complete the demonstration of the presence of organisms of this group, it is necessary to show that one or more aerobic plate colonies consist of Gram-negative non-spore-forming bacilli, which, when inoculated into a lactose broth fermentation tube, form gas.

6. Reporting Results

In reporting results, the particular test (Presumptive, Confirmed or Completed) applied to the sample should be recorded.

7. Differentiation

When it is desired to differentiate between the various sections of the coliform group, the detailed procedure shall not follow primary planting in liquid media, but shall be based upon primary planting of the sample in solid media.

B. Presumptive Test

1. Procedure

Inoculate a series of lactose broth fermentation tubes with appropriate graduated quantities of the water to be tested.

Comparatively large volumes (*e. g.*, 100 ml.) of sample, intended for detection of the presence of coliform organisms, may be planted directly into lactose broth at the site of collection of the sample, using ordinary dilution bottles, 6 or 8 ounce bottles, containing multiple-strength lactose broth and equipped with inverted vial or Cowles tube. Such bottles may be marked with graduations to eliminate the necessity of using pipettes for transfer of medium and sample.

Incubate the fermentation tubes at 35° to 37° C. for 48 ± 3 hours unless gas appears earlier. Examine each tube at the end of 24 ± 2 hours and if no gas has formed, again at the end of 38 ± 3 hours. Record presence or absence of gas formation at each examination of the tubes.

More detailed records of the amount of gas formed, though desirable for the purpose of study, are not necessary for performing the standard tests prescribed.

Formation with 24 ± 2 hours of gas in the inverted vial in the fermentation tube constitutes a Positive Presumptive Test.

If no gas is formed in 24 ± 2 hours, the incubation shall be continued to 48 ± 3 hours. If gas in any quantity is present at the end of the second but not the first twenty-four hours incubation period, the test is considered as doubtful and the presence of organisms of the coliform group should be confirmed by means of the procedure described in "C" or "D," which follow.

The absence of gas formation at the end of 48 ± 3 hours' incubation constitutes a negative test. (An arbitrary limit of forty-eight hours' observation doubtless excludes from consideration occasional members of the coliform group which form gas very slowly, but for the purpose of a standard test the exclusion of these occasional slow gas-forming organisms is considered immaterial.)

C. Confirmed Test

The use of Endo or eosin methylene-blue plates, or of the liquid confirmatory brilliant-green lactose bile is permitted.

Crystal violet broth may be used as an alternate medium where its use has been shown to yield a maximum number of coliform organisms as indicated by a series of completed tests.

It is desirable that all lactose broth tubes showing gas at the end of twenty-four hours and those showing gas only at the end of 48 hours' incubation be submitted to this test. In routine work, however, it is permissible to submit to the Confirmed Test all the lactose broth tubes showing gas, of those containing the two highest dilutions (dilutions containing the smallest portions) of sample that have produced gas.

Thus, if only one or two dilutions of sample have been planted in lactose broth tubes, all tubes showing gas shall be confirmed, but if three or more dilutions of samples have been planted, only the tubes showing gas from the two highest gas-producing dilutions of sample need be submitted to the Confirmed Test.

For example, if 5 tubes of each of three dilutions are planted, and if gas appears in all tubes, the 5 tubes of the highest dilution and the 5 tubes of the middle dilution should all be confirmed. Again, if gas appears in only 1 of the 5 tubes of the highest dilution, three of the middle dilution, and four of the lowest dilution, only the 1 tube of the highest and the 3 tubes of the middle dilution showing gas need be confirmed.

In such cases all remaining lactose broth tubes showing gas that have not been submitted to the Confirmed Test shall be recorded as containing coliform organisms, even though all the Confirmed Tests made yield negative results.

Transfers from the lactose broth tubes to plates or to confirmatory liquid media should be made as soon as gas appears. In routine work, however, it is permissible to make observations and transfers at 24 ± 2 hours and 48 ± 3 hours of incubation.

1. Procedure

1.1. Endo or eosin methylene-blue plates. Streak one or more plates from each of the selected tubes showing gas formation in lactose broth; it is essential that

the plates be so streaked as to insure the presence of some discrete colonies, separated by at least 0.5 cm. from one another.

1.1.1. Incubate the plates at 35° to 37° C. for 24 ± 2 hours.

1.1.2. Results, typical (Escherichia coli) or atypical.

If typical Escherichia coli colonies have developed on the plate within the incubation period of 24 ± 2 hours, the result of the confirmed test may be considered positive.

If only atypical colonies have developed within 24 ± 2 hours, the result cannot yet be considered definitely negative, since many coliform organisms fail to form typical colonies on Endo or eosin methylene-blue plates, or the colonies develop slowly. In such case, it is always necessary to complete the test as directed under "D," below.

1.2. Brilliant-green lactose bile broth. Transfer from the lactose broth tube showing gas to a fermentation tube containing brilliant-green lactose bile broth.

When making transfers from the lactose broth tube showing gas, the tube shall first be gently shaken, or mixed by rotating, and the transfer shall be made by means of a wire loop not less than 3 mm. in diameter.

1.2.1. Incubate the inoculated brilliant-green lactose bile broth tube for 48 ± 3 hours at 35° to 37° C.

1.2.2. The formation and presence of gas in any amount in the inverted vial of the fermentation tube at any time within 48 ± 3 hours constitutes a Confirmed Test.

1.2.3. If the brilliant-green lactose bile broth tube is decolorized before or at the end of the forty-eight hour incubation period, the Completed Test, as in "D" below, should immediately be performed. (It has been suggested that when such decolorization, probably due to *Cl. welchii*, takes place, a transfer should be made at once to broth containing 2 per cent dried bile and 1:25,000 brilliant-green or to formate ricinoleate broth. If gas appears within 48 ± 3 hours at 35° to 37° C., the culture should be submitted to the Completed Test.)

D. Completed Test

1. Procedure

The Completed Test may be performed upon the lactose broth tubes showing gas, the colonies found upon plates used for the Confirmed Test (C, 1.1), or the brilliant-green lactose bile broth tubes, showing gas, used for the Confirmed Test (C, 1.2).

1.1. Lactose broth tubes. If the lactose broth tubes are used for the Completed Test, the choice of these tubes to be tested shall be that specified for the Confirmed Test in "C."

1.1.1. Streak one or more Endo or eosin methylene-blue plates from each lactose broth tube to be tested. Careful attention to the following details, when streaking plates, will result in a high proportion of successful isolations if coliform organisms are present:

a. Employ a straight needle slightly curved at the tip. By bringing only the curved section of the needle in contact with the agar surface, the latter will not be scratched or torn.

b. Incline the lactose broth tube to avoid picking up any membrane or scum on the needle.

c. Insert the end of the needle into the liquid in the tube to a depth of approximately 1.0 mm.

d. Then streak the plate, covering completely the whole agar surface.

Incubate the plate (inverted, if without porous cover) at 35° to 37° C. for 24 ± 2 hours.

1.2. Brilliant-green lactose bile broth tubes. If the brilliant-green lactose bile broth tubes used for the Confirmed Test are to be employed for the Completed Test, streak one or more Endo or eosin methylene-blue plates from each brilliant-green lactose bile broth tube showing gas, as soon as possible after appearance of gas, following closely the directions indicated in 1.1. Incubate the plates at 35° to 37° C. for 24 ± 2 hours.

1.3. Identification. From each of the plates used for the Confirmed Test, or from those made from the lactose broth or brilliant-green lactose bile broth tubes (D, 1.1 or 1.2), fish one or more typical Escherichia coli colonies; or, if no such typical colonies are present, fish two or more colonies considered most likely to consist of organisms of the coliform group, transferring each to an agar slant and a lactose broth fermentation tube.

When transferring colonies, care should be taken to choose, if possible, well isolated colonies separated by at least 0.5 cm. from other colonies, and barely to touch the surface of the colony with the needle in order to minimize the danger of transferring a mixed culture.

The secondary lactose broth fermentation tubes thus inoculated shall be incubated at 35° to 37° C. until gas formation is noted—the incubation not to exceed 48 ± 3 hours.

The agar slants shall likewise be incubated at 35° to 37° C. for 24 to 48 ± 3 hours, and Gram-stained preparations from those corresponding to the secondary lactose broth tubes that show gas shall be examined microscopically.

1.4. Results. The formation of gas in lactose broth and the demonstration of Gram-negative, non-spore-forming bacilli in the agar culture shall be considered a satisfactory Completed Test, demonstrating the presence of a member of the coliform group.

The absence of gas formation in lactose broth or failure to demonstrate Gram-negative non-spore-forming abcilli in a gas-forming culture constitutes a negative test.

When spore-forming lactose-fermenting organisms are found, the culture should be further studied to ascertain the possible presence of bacteria of the coliform group associated with the spore-bearing organisms. This may be done by transferring the culture to formate ricinoleate broth and incubating at 35° to 37° C. for 48 ± 3 hours.

If no gas is produced, only spore-forming lactose fermenters may be considered to be present. If gas is produced in the formate ricinoleate broth, the probable presence of coliform group organisms should be verified by inoculation from the formate ricinoleate to a tube of standard lactose broth and to an agar slant.

If, after 48 ± 3 hours, gas is produced in the former and no spores in the latter, the test may be considered "completed" and the presence of coliform organisms demonstrated.

If spores are present, for practical purposes, organisms of the coliform group may be considered absent.

E. Technic for the Gram Stain

The "Completed Test" for coliform group organisms includes the determination of Gram stain characteristics of the organisms isolated.

A word of caution is necessary regarding the interpretation of Gram stain results. Organisms are so generally recorded in the literature as either Gram-positive or Gram-negative, that this stain is often considered to give a clear-cut reaction as definite as a chemical test. Many organisms, however, are actually Gram-variable; and to determine their predominant tendency in this respect, repeated tests are needed.

There are a large variety of modifications of the Gram stain, many of which have been listed by Hucker and Conn. The following Hucker modification is valuable for staining smears of pure cultures.

1. Reagents

1.1. Ammonium oxalate crystal violet.

1.1.1. Solution A. Dissolve 2 g. of crystal violet, with 85 per cent dye content, in 20 ml. of 95 per cent ethyl alcohol.

1.1.2. Solution B. Dissolve 0.8 g. of ammonium oxalate in 80 ml. of distilled water.

1.1.3. Mix solutions A and B ordinarily in equal parts. It is sometimes found, however, that this gives so concentrated a stain that Gram-negative organisms

such as the gonococcus, do not properly decolorize. To avoid this difficulty, solution A may be diluted as much as ten times and 20 ml. of the diluted solution mixed with an equal quantity of solution B.

1.2. Lugol's Solution; Gram's Modification. Dissolve 1 g. of iodine crystals, and 2 g. of potassium iodide in 300 ml. of distilled water.

1.3. Counterstain. Make an alcoholic solution of safranin dye by dissolving 2.5 g. in 100 ml. of 95 per cent ethyl alcohol.

Add 10 ml. of the alcoholic solution of safranin to 100 ml. of distilled water.

2. Procedure

Stain the smear for one minute with the crystal violet solution. Wash slide in water; immerse in iodine solution for one minute.

Wash stained slide in water; blot dry. Decolorize with 95 per cent ethyl alcohol for thirty seconds; use gentle agitation.

Blot and cover with counterstain for ten seconds. Then wash, dry, and examine as usual.

Cells which decolorize and accept the safranin stain are Gram-negative. Cells which so not decolorize, but retain the crystal violet stain, are Gram-positive.

F. Selection of Coliform Tests

The laboratory worker, when he elects to apply either the Presumptive, Confirmed or the Completed Test for the coliform group, shall be guided by the following basic considerations.

1. Presumptive Test

The Presumptive Test may be applied to gas-forming portions of:

—any sample of sewage, sewage effluent (except chlorinated effluent) or water known to be heavily polluted, the fitness of which for use as drinking water is not under consideration.

—any routine sample of raw water in a purification plant, provided that records indicate the Presumptive Test to be not too inclusive for the production of data statistically comparable to that obtained from the finished water.

2. Confirmed Test

The Confirmed Test may be applied to the gas-forming portions:

—in the examination of any water to which the Presumptive Test is known, from previous records, to be not applicable.

—in the routine examination of samples of drinking water, water in process of purification and finished waters.

—in the examination of chlorinated sewage effluents.

3. Completed Test

The Completed Test shall be applied to the gas-forming portions:

—in the examination of any water to which the applicability of the Confirmed Test is in reasonable doubt. Laboratories responsible for the quality of the raw or finished water supplied to large communities shall employ the Completed Test, if not exclusively to these raw or finished waters, at least to such a proportion of samples as to establish beyond reasonable doubt the applicability to them of the Confirmed Test.

PUBLIC HEALTH SERVICE DRINKING WATER STANDARDS

Standards Promulgated by the United States Public Health Service, Federal Security Agency, February 5, 1946, for Drinking and Culinary Water Supplied by Carriers Subject to the Federal Quarantine Regulations

3.2 *Application.* Applications 3.21 and 3.22 given below shall govern when ten milliliter (10 ml.) portions are used and applications 3.23 and 3.24 shall govern when one hundred milliliter (100 ml.) portions are used.

3.21 Of all the standard ten milliliter (10 ml.) portions examined per month in accordance with the specified procedure, not more than ten (10) per cent shall show the presence of organisms of the coliform group.

3.22 Occasionally three (3) or more of the five (5) equal ten milliliter (10 ml.) portions constituting a single standard sample may show the presence of organisms of the coliform group, provided that this shall not be allowable if it occurs in consecutive samples or in more than:

a) Five (5) per cent of the standard samples when twenty (20) or more samples have been examined per month.

b) One (1) standard sample when less than twenty (20) samples have been examined per month.

Provided further that when all five of the standard one hundred milliliter (100 ml.) portions constituting a single standard sample show the presence of organisms of the coliform group, daily samples from the same sampling point shall be collected promptly and examined until the results obtained from at least two consecutive samples show the water to be of satisfactory quality.

3.25 The procedure given, using a standard sample composed of five standard portions, provides for an estimation of the most probable number of coliform bacteria present in the sample as set forth in the following tabulation:

Number of portions		*Most probable number of coliform bacteria per 100 ml.*	
Negative	*Positive*	*When 5–10 ml. portions are examined*	*When 5–100 ml. portions are examined*
5	0	Less than 2.2	Less than 0.22
4	1	2.2	.22
3	2	5.1	.51
2	3	9.2	.92
1	4	16.0	1.60
0	5	More than 16.0	More than 1.60

INFORMATION ON WELLS*

Well No. or designation__________Date__________Est. No.__________

1. Depth?________ 2. Size of well bore?________ 3. Drilled or dug? ________

4. Strata (soil) through which well is dug or drilled?____________________

____

____

5. Nature of bottom of well?____ 6. Height of water in well?____ 7. How pumped?____

8. Location at plant in respect to buildings, cattle pens, sewers, etc.__________

____

____

9. Approximate capacity or yield?____________________

10. Does it show seasonal changes of any kind?____________________

11. Is it affected by prolonged or heavy rains?____________________

* United States Department of Agriculture, Agricultural Research Administration, Bureau of Animal Industry.

12. Proximity to river, pond, swamp, or surface water? ______

______

13. Describe top of well:

a. Protection from surface water and height of top above surface water? ______

______

______

b. Height of casing above or below ground level? ______

c. Surface level on low or high ground? ______

d. Nature of slope of ground to or from well with relation to plant, rivers, other surface water? ______

______

14. Where is water from this well pumped? ______

15. Where can samples of this well be taken?

a. Tap at pump? ______ *b.* Tap in direct line from pump? ______

c. Outlet at reservoir or other points? ______

16. How long has well been in use? ______

a. Has it been pumped continually or intermittently? ______

17. Other information: ______

______

______

Signed ______

COOK PORK AND ITS PRODUCTS THOROUGHLY*

Pork forms an important part of the diet in most American families. As with many other foods, certain hygienic precautions are needed in preparing pork for food purposes. Most fruits and vegetables are washed or peeled. Milk is commonly pasteurized to destroy harmful bacteria that may be present. Water supplies are treated, if necessary, for purification and safety to health. Proper cooking is a valuable scientific safeguard in the case of numerous foods, including pork. Fresh pork should always be cooked so that it is "done" throughout.

REASONS FOR THOROUGH COOKING

Cooking is necessary since a small percentage of hogs harbor a parasite known scientifically as *Trichinella spiralis*. The common name of the parasites is trichinæ. They are extremely small and are not seen except upon microscopic examination. Even then they are likely to escape detection. The parasites cause hogs that survive the disease no particular inconvenience so far as can be judged from the external appearance of these animals, and when pork from affected hogs is cooked the organisms are no more dangerous than bacteria in pasteurized milk, in purified water, or in canned vegetables. But failure to cook fresh pork thoroughly may result in a condition known as trichinosis.

* Series A. I. 39 United States Department of Agriculture, Bureau of Animal Industry.

The seriousness of this ailment depends on the number of live trichinæ in the pork eaten. Slight infestation following the consumption of moderate quantities of lightly infested pork that is raw or imperfectly cooked may pass unnoticed or may cause but slight illness. But the consumption of heavily infested pork or of large quantities of raw or imperfectly cooked pork that is lightly infested may produce a painful and sometimes fatal attack of trichinosis. Common symptoms are nausea, vomiting, diarrhea, severe abdominal pains, general dullness, weakness, twitching of muscles, and sensations of tension and pain in the muscles. In later stages of the disease the eyeballs may become inflamed or show small hemorrhages. Swelling of the legs, forearms, abdominal wall, and face may occur, sometimes with skin eruptions. Muscular pain is an outstanding symptom of trichinosis. Fever is commonly present during the first stage of the disease, reaching its height in about 10 days after the first symptoms. The symptoms are by no means constant, and typical cases have sometimes been diagnosed as typhoid fever, undulant fever, meningitis, and other diseases. When patients are seen by a physician within a few days after eating the trichinous pork and the disease is correctly diagnosed, some good may follow attempts to expel the parasites from the digestive tract.

MAIN SOURCES OF TRICHINOSIS

The disease is most commonly found among persons of foreign origin or descent. The reason is that people of certain European countries often retain their native fondness for raw or imperfectly cooked pork. Trichinosis is not limited to people of such foreign descent, however, since many affected persons have been of American birth or of American ancestry.

Outbreaks of trichinosis occur at all seasons of the year but usually in winter, especially during the holidays when various products containing pork are eaten without proper cooking in some households. Besides fresh pork and sausage, and smoked hams and shoulders, and bacon that may not be thoroughly cooked, such products as smoked sausage, boneless loins, capicola, coppa, and forms of dry or summer sausage, if prepared in establishments not operated under Federal meat inspection or other competent inspection, are the main sources of trichinosis in this country.

There are cases of entire families being stricken as a result of eating uncooked or improperly cooked sausage or other products made from the meat of one hog. Even tasting uncooked sausage during its preparation to ascertain when the seasoning is satisfactory may cause trichinosis. The consumption of hastily cooked hamburgers consisting of a mixture of ground beef and pork is likely to cause trichinosis. Numerous cases have resulted from the serving of uncooked pork products at a family gathering or reunion. In such cases the meat is usually from one hog and is more dangerous in this respect than pork products which are the composite result of the meat from many hogs, as in packing-house products. When the meat is obtained from several hogs, the chance of many of the parasites being present is reduced.

PORK IS NOT INSPECTED FOR TRICHINÆ

There is no practicable system of inspection by which persons who eat uncooked pork can be protected from trichinæ. Under Federal meat inspection pork is not examined microscopically for trichinæ. Although microscopic inspection would perhaps eliminate most of the heavily infested hog carcasses, many which would be dangerous were the meat eaten without proper treatment would be overlooked.

In the United States, in establishments operating under Federal meat inspection, pork products of any kind that are customarily eaten without cooking by the consumer are especially processed to destroy trichinæ and are thus rendered safe. These methods of processing, which involve cooking, special freezing, or special curing, are conducted under the close scrutiny of the inspector. The methods other than cooking are not applicable to the preparation of pork products in the home and on the farm.

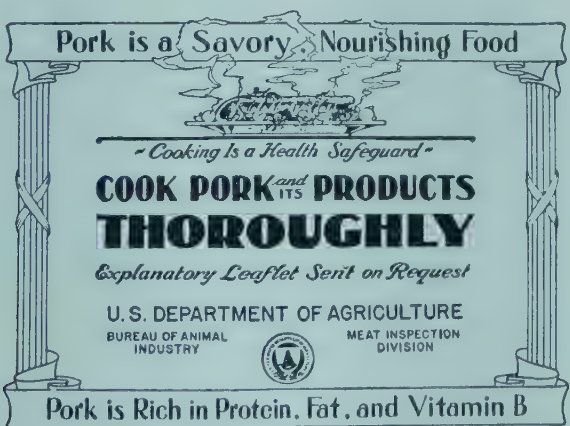
LARGE PIECES REQUIRE MORE COOKING

In cooking pork, remember that large pieces require much more cooking than small ones because the heat penetrates slowly into the center of the meat. Large pieces that are well cooked on the outside may be imperfectly cooked or even entirely raw at the center. The housewife should, therefore, use care in preparing pork to see that it is thoroughly cooked throughout if trichinosis is to be avoided. Particular care should be taken in cooking pork chops well done to the bone. A good test for "doneness" of chops and also of loin roasts is to make small incisions next to the bone as well as into the thicker part of the meat to be sure that the meat is thoroughly cooked. For hams and shoulders the only sure guide to sufficient cooking is a meat thermometer stuck into the center of the thickest portion of the cut to show when the meat is well done all through. However, 30 minutes to the pound is an approximate guide to sufficient cooking of large thick cuts of pork. The consumer is reminded also that frozen or very cold meat requires a longer period of cooking than meat of ordinary temperature. Processed sausage should always be cooked unless the consumer knows definitely that these products were especially processed, under Federal supervision or equally reliable State or local supervision, to be eaten without cooking. Sausage purchased from farmers and peddlers should be cooked in all cases.

The thorough cooking of pork is advisable not only for hygienic reasons, but also for the development of a rich flavor. The Bureau of Home Economics, U. S. Department of Agriculture, makes the following recommendations: "Success in preparing pork cuts depends on regulating the heat so as to cook the meat well done to the center of the piece, and at the same time to keep the outside from becoming hard and dry. Moderate cooking temperature is best after the surface has been browned to develop rich flavor."

THE POSTER IS A REMINDER

As a reminder to the public, the United States Department of Agriculture has prepared a poster, similar to the one reproduced herewith, entitled "Cook Pork and Its Products Thoroughly." It has been prepared for display in meat shops. The display of this poster is entirely voluntary and represents the cooperation of the meat trade with the United States Department of Agriculture for the benefit of the public.



FOOD INSPECTION ACT*

An Act relating to the public health, safety, and welfare, providing for: the establishment of a food inspection bureau; the inspection of articles of human food; the condemnation and destruction for food purposes of diseased, unsound, or other-

* Reprint from the Journal of the American Veterinary Medical Association. Vol. CVIII, No. 831, June, 1946, pp. 389–392. "Proposed Code for the Inspection of Human Food."

wise unfit food; the prevention of misbranding and adulteration of food; the issuance of licenses and collection of fees; the adoption of regulations for the administration of the Act; and, penalties for violations of the Act.

BE IT ENACTED BY THE
LEGISLATURE OF THE STATE OF
COMMISSIONERS OF THE COUNTY OF ———
COUNCIL OF THE CITY OF

Section 1—Definitions

For the purpose of this Act the following words, phrases, names, and terms shall be construed, respectively, to mean:

a) **Bureau.**—The Food Inspection Bureau established by this Act.

b) **Inspector.**—An inspector of the bureau, authorized by the chief of bureau to do any work or perform any duty in connection with food inspection under this Act.

c) **Licensed Plant.**—Any food handling plant licensed under this Act.

d) **Food.**—Any article capable of being used for human food and which is subject to regulation by the

State
County of ———————.
City

e) **Animal.**—Cattle, calves, sheep, swine, goats, and other domestic food animals, including poultry.

f) **Carcass.**—All parts, including viscera, of a slaughtered animal that are capable of being used for human food.

g) **Meat and Product; Meat or Product.**—Carcasses, parts of carcasses, meat and products of, or derived from, cattle, calves, sheep, swine, goats, and other domestic food animals including poultry, which are capable of being used for human food.

h) **Person.**—Natural person, partnership, corporation, or other organization, and every officer, agent or employee thereof. This term shall mean either the singular or the plural as the case may be.

Section 2—Administration

a) **Organization of Bureau.**—There shall be organized a Food Inspection Bureau which shall be charged with the enforcement of this Act.

b) **Chief of Bureau.**—The Chief of Bureau shall be a duly qualified veterinarian, graduate of a school approved by the American Veterinary Medical Association.

c) **Inspectors; Qualifications; Appointments.**—The Chief of Bureau shall cause to be appointed such inspectors as may be necessary to carry out the provisions of this Act. Appointees shall meet all applicable civil service rules and regulations: PROVIDED, That veterinary inspectors shall be duly qualified veterinarians, graduates of schools approved by the American Veterinary Medical Association: AND PROVIDED FURTHER, That, other inspectors shall meet such qualifications as the Chief of Bureau may prescribe.

Section 3—Licenses

a) **Licensee.**—No person shall operate any slaughtering plant, packing plant, wholesale distributing plant, retail market, restaurant, or other food handling establishment unless he shall first have applied for and been granted a license as provided under this Act.

b) **Application for License.**—The owner or operator of each plant or establishment of the kind specified in (*a*) of this section shall make application to the Chief of Bureau for a license to operate such plant. The application shall be on a form furnished by the Bureau. In case of change of ownership or change of location a new application shall be made.

c) **Granting License.**—The Chief of Bureau shall investigate all circumstances in connection with the application for license to determine whether the applicable requirements of this Act and regulations made pursuant thereto have been complied with. The Chief of Bureau shall grant or refuse the license upon the basis of facts pertaining to the applicable requirements disclosed by his investigation. Each license shall bear an identifying number.

d) **Revocation of License.**—The Chief of Bureau may revoke any license if he determines that any false statement was made in the application or if he finds that there is any failure to comply with the applicable provisions of this Act or regulations made pursuant thereto.

Section 4—Plant Construction and Equipment

a) **Construction.**—Every licensed plant shall be constructed and maintained with materials susceptible of being readily and thoroughly cleaned. The plant shall not be located near any source of fly breeding or similar public nuisance. Rooms and compartments used for handling or preparing food products shall be separate and distinct from those used for handling or preparing inedible products. Floors and walls shall be smooth and impervious. An efficient drainage system with approved traps and vents shall be provided. There shall be ample light and ventilation. Suitable dressing rooms, toilet rooms, and urinals shall be provided. Modern hand-washing facilities shall be located wherever necessary to assure cleanliness of all persons handling food.

b) **Equipment.**—Every licensed plant shall provide for proper handling of food and efficient conduct of inspection all necessary tables, benches, receptacles, utensils, and other articles of equipment of such materials and construction as will make them susceptible of being readily and thoroughly cleaned.

c) **Cleanliness.**—The outer premises and all parts of a licensed plant and its equipment shall be kept clean. Flies, rats, and other vermin shall be excluded from such plants.

d) **Water Supply and Sewage Disposal.**—The water supply of a licensed plant shall be ample, clean, and potable and protected against contamination and pollution. An ample supply of both hot and cold water shall be distributed throughout the plant as may be necessary. An adequate and acceptable sewage disposal system shall be provided.

Section 5—Ante-mortem Inspection

a) **Provision for Ante-mortem Inspection.**—The Chief of Bureau may require to be made, by an inspector, an ante-mortem inspection of all animals about to be slaughtered. Such inspection shall be made on the day of slaughter. No animal shall be slaughtered without such inspection as the Chief of Bureau may require under this section.

b) **Facilities and Assistance.**—The owner or operator of each licensed plant where slaughtering is conducted shall furnish such facilities and assistance as may be required by the Chief of Bureau to permit the inspector to make his inspections efficiently.

c) **Disposition of Animals.**—Veterinary inspectors shall dispose of animals on ante-mortem inspection in conformity with such provisions of the appropriate federal inspection regulations as may be adopted by the Chief of Bureau from time to time in his regulations under this Act, whether the animals are released for slaughter, held as suspects, or condemned.

Section 6—Post-mortem Inspection

a) **Provision for Postmortem Inspection.**—The Chief of Bureau may require that meat or product be derived from carcasses that have received and passed a post-mortem inspection made at the time of slaughter. No meat or product shall be prepared or distributed in the channels of trade without having received such post-mortem inspection as the Chief of Bureau may require under this section.

b) **Facilities and Assistance.** The owner or operator of each licensed plant where slaughtering is conducted shall furnish such facilities as may be required by the Chief of Bureau to permit the efficient conduct of post-mortem inspection and to maintain the identity of all carcasses with their respective parts until the inspection has been completed.

c) **Disposition of Carcasses.**—Veterinary inspectors shall dispose of carcasses on post-mortem inspection in conformity with such provisions of the appropriate Federal inspection regulations as may be adopted by the Chief of Bureau from time to time in his regulations under this Act, whether the carcasses are passed for food or condemned.

Section 7—Time of Operation

a) **Time of Operation.**—The Chief of Bureau may require operations at licensed plants to be conducted during reasonable hours. The owner or operator of each licensed plant shall keep the Chief of Bureau informed in advance of intended hours of operations. When one inspector is detailed to make inspections at two or more plants where few animals are slaughtered or where but a small quantity of food is prepared, the Chief of Bureau may designate the hours of the day and the days of the week during which such plants may be operated.

Section 8—Preparation and Handling

a) **Food Subject to Inspection.**—All food in the channels of trade, whether fresh, frozen, cured, or otherwise prepared, even though previously inspected and passed, shall be subject to reinspection by Bureau inspectors as often as may be necessary in order to ascertain whether such food is sound, healthful, wholesome, and fit for human food. If upon reinspection any food is found to have become unsound, unhealthful, unwholesome, or in any way unfit for human food, it shall be condemned: Provided, That: When a food is found to be affected by any unsound or unwholesome condition that can be satisfactorily removed by methods approved by the Chief of Bureau, such food may be so reconditioned under the direction of a Bureau inspector. If upon final inspection the food is found to be sound and wholesome, it shall be passed for human food; otherwise it shall be condemned.

b) **Processing Operations to be Conducted Under Inspection.**—The owner or operator of each licensed plant shall inform the Chief of Bureau in advance regarding any food processing operations such as canning, cooking, curing, smoking, salting, rendering, freezing, etc., at his plant, and shall conduct such operations only at such times and in such manner as the Chief of Bureau may prescribe to assure clean handling of food and to afford opportunity for inspection.

c) **Chemical Preservatives, Etc.**—No food shall contain any dye, chemical, preservative, or other substance which impairs its wholesomeness or which is not approved by the Chief of Bureau.

d) **Trichinae.**—Inasmuch as it can not certainly be determined, by any present known method of inspection, whether the muscle tissue of pork contains trichinæ, and inasmuch as live trichinæ are dangerous to health, no article of a kind prepared customarily to be eaten without cooking shall contain any muscle tissue of pork unless the pork has been subjected to a temperature sufficient to destroy all live trichinæ, or other treatment prescribed by the Chief of Bureau.

Section 9—Inspection Legend

a) **Inspection Legend Prescribed.**—An inspection legend embodying the license number shall be applied by an employee of the licensed plant, under the supervision of an inspector, to such meat and product processed in such plant as the Chief of Bureau may require to be so marked. The inspection legend shall be in such form and design as the Chief of Bureau may prescribe to indicate that the food has been inspected and passed in accordance with this Act. At the discretion of the Chief of Bureau, the inspection legend and license number may be used on other foods processed at licensed plants.

Section 10—Labeling

a) **False or Deceptive Names.**—No label or mark on any food shall convey any false impression of identity, quality, or origin, and no container or covering of a food shall be so made, formed, or filled as to be deceptive or misleading.

b) **Labels.**—The Chief of Bureau may require food to bear such labels or marks as may be necessary to prevent deception. The label of a food shall include, prominently and informatively displayed: (1) The common or usual name of the product; (2) a list of the ingredients used in preparing the food if it is fabricated from two or more ingredients; (3) the name and place of business of the manufacturer, packer, or distributor; and, (4) an accurate statement of the quantity of contents.

c) **Composition of Food.**—The Chief of Bureau may prescribe such rules and regulations as may be necessary to control effectively the composition and processing of food for the purpose of preventing deception.

Section 11—Access to Premises

a) **Access to Premises.**—Inspectors shall be entitled to access at any time upon proper identification at all regular entrances and to all parts of premises for the purpose of making inspections under this Act.

Section 12—Embargo and Seizure—Disposal of Seized Food

a) **Embargo and Seizure.**—The Chief of Bureau is authorized to prohibit the importation into the channels of sale of this jurisdiction of food that is unsound, unwholesome, improperly labeled, or otherwise not in accordance with this Act. Any food found in the channels of sale within this jurisdiction by a Bureau inspector to be not in accordance with this Act shall be subject to seizure and confiscation by a Bureau inspector.

b) **Disposal of Seized Food.**—Seized food shall be condemned by a Bureau inspector unless it is of such character that it can be made to conform with this Act by methods approved by the Chief of Bureau. Condemned food shall be effectively destroyed for food purposes by the owner or handler of the food under the supervision of an inspector in such manner as the Chief of Bureau may prescribe.

Section 13—Appeals

a) **Appeals from Inspector's Actions.**—Any appeal from a decision of an inspector shall be made to his immediate superior having jurisdiction over the subject matter of the appeal.

Section 14—Rules and Regulations

a) **Authority to Make Regulations.**—The Chief of Bureau shall make such rules and regulations as may be necessary for the efficient execution of the provisions of this Act.

Section 15—Financing

a) **Appropriation.**—There is authorized to be appropriated annually the sum of \$———— to carry out the purpose of this Act.

b) **Fees.**—The Chief of Bureau is authorized to establish reasonable fees to be collected from owners or operators of licensed plants, only in such amounts as may be necessary to defray the cost, if any, required in excess of the sum provided by the annual appropriation to carry out the purposes of this Act. Such fees shall be equitably prorated and shall be paid to the treasurer of the $\left\{\begin{matrix}\text{State}\\ \text{County}\\ \text{City}\end{matrix}\right\}$ who shall credit the same solely to the above appropriation.

Section 16—Reports

a) **Inspection Reports.**—Reports of the work of inspection in licensed plants and elsewhere shall be made by inspectors on such forms and in such manner as the Chief of Bureau may specify.

b) **Information to be Furnished by Owners and Operators.** The owner or operator of each licensed plant shall furnish to Bureau inspectors accurate information as to all matters needed by them for making their reports.

Section 17—Cooperation with Other Agencies

a) **Cooperation with Other Agencies.**—The Chief of Bureau is authorized and directed to maintain a close working relationship with other public health and disease-control agencies to arrange a full exchange of information and correlate their respective activities.

Section 18—Inspection—Penalties

a) **Scope of This Act:**—This Act shall have effect throughout the

$\left\{\begin{matrix}\text{State}\\ \text{County}\\ \text{City}\end{matrix}\right\}$ of————.

b) **All Food Subject to Inspection.**—No food shall be handled or transported in the channels of trade within the purview of this Act without such inspection as the Chief of Bureau may prescribe under this Act, except that a comparable inspection by an appropriate agency of the Federal Government or other agencies may be accepted by the Chief of Bureau.

c) **Penalties.**—Any person violating any of the provisions of this Act, or the rules, regulations, or orders properly issued thereunder, upon conviction, shall be deemed guilty of a misdemeanor and punished by a fine not to exceed $———, or imprisonment for a period of not more than ————, or both such fine and imprisonment at the discretion of the court.

Section 19—Saving Clause

a) **Saving Clause.**—If any section, paragraph, or sentence of this Act, or its application to any person, or in particular circumstances, is for any reason held to be invalid, such decision shall not affect the validity of remaining portions of this Act or its application to other persons or in other circumstances.

Section 20—Inconsistent Acts

a) **Inconsistent Acts.**—Insofar as they conflict with the provisions of this Act, previous acts of this jurisdiction are superseded.

Section 21—Effective Date

a) **Effective Date.**—This Act shall take effect and be in force from and after ——.

THE MEAT-INSPECTION ACT

Extract from an act of Congress entitled "An act making appropriations for the Department of Agriculture for the fiscal year ending June thirtieth, nineteen hundred and seven," approved June 30, 1906 (34 Stat. 674), and from an act of Congress entitled "An act making appropriations for the Department of Agriculture for the fiscal year ending June thirtieth, nineteen hundred and eight," approved March 4, 1907 (34 Stat. 1260).

[1] That hereafter, for the purpose of preventing the use in interstate or foreign commerce, as hereinafter provided, of meat and meat food products which are unsound, unhealthful, unwholesome, or otherwise unfit for human food, the Secretary of Agriculture, at his discretion, may cause to be made, by inspectors appointed for that purpose, an examination and inspection of all cattle, sheep, swine, and goats before they shall be allowed to enter into any slaughtering, packing, meat-canning, rendering, or similar establishment, in which they are to be slaughtered and the meat and meat food products thereof are to be used in interstate or foreign commerce; and all cattle, swine, sheep, and goats found on such inspection to show symptoms of disease shall be set apart and slaughtered separately from all other cattle, sheep, swine, or goats, and when so slaughtered the carcasses of said cattle, sheep, swine, or goats shall be subject to a careful examination and inspection, all as provided by the rules and regulations to be prescribed by the Secretary of Agriculture as herein provided for.

[2] That for the purposes hereinbefore set forth the Secretary of Agriculture shall cause to be made by inspectors appointed for that purpose, as hereinafter provided, a post-mortem examination and inspection of the carcasses and parts thereof of all cattle, sheep, swine, and goats to be prepared for human consumption at any slaughtering, meat-canning, salting, packing, rendering, or similar establishment in any State, Territory, or the District of Columbia for transportation or sale as articles of interstate or foreign commerce; and the carcasses and parts thereof of all such animals found to be sound, healthful, wholesome, and fit for human food shall be marked, stamped, tagged, or labeled as "Inspected and Passed;" and said inspectors shall label, mark, stamp, or tag as "Inspected and Condemned," all carcasses and parts thereof of animals found to be unsound, unhealthful, unwholesome, or otherwise unfit for human food; and all carcasses and parts thereof thus inspected and condemned shall be destroyed for food purposes by the said establishment in the presence of an inspector, and the Secretary of Agriculture may remove inspectors from any such establishment which fails to so destroy any such condemned carcass or part thereof, and said inspectors, after said first inspection shall, when they deem it necessary, reinspect said carcasses or parts thereof to determine whether since the first inspection the same have become unsound, unhealthful, unwholesome, or in any way unfit for human food, and if any carcass or any part thereof shall, upon examination and inspection subsequent to the first examination and inspection, be found to be unsound, unhealthful, unwholesome, or otherwise unfit for human food, it shall be destroyed for food purposes by the said establishment in the presence of an inspector, and the Secretary of Agriculture may remove inspectors from any establishment which fails to so destroy any such condemned carcass or part thereof.

[3] The foregoing provisions shall apply to all carcasses or parts of carcasses of cattle, sheep, swine, and goats, or the meat or meat products thereof which may be brought into any slaughtering, meat-canning, salting, packing, rendering, or similar establishment, and such examination and inspection shall be had before the said carcasses or parts thereof shall be allowed to enter into any department wherein the same are to be treated and prepared for meat food products; and the foregoing provisions shall also apply to all such products which, after having been issued from any slaughtering, meat-canning, salting, packing, rendering, or similar establishment, shall be returned to the same or to any similar establishment where such inspection is maintained.

[4] That for the purposes hereinbefore set forth the Secretary of Agriculture shall cause to be made by inspectors appointed for that purpose an examination and inspection of all meat food products prepared for interstate or foreign commerce in any slaughtering, meat-canning, salting, packing, rendering, or similar establishment, and for the purposes of any examination and inspection said inspectors shall have access at all times, by day or night, whether the establishment be operated or not, to every part of said establishment; and said inspectors shall mark, stamp, tag, or label as "Inspected and Passed" all such products found to be sound, healthful, and wholesome, and which contain no dyes, chemicals, preservatives, or ingredients which render such meat or meat food products unsound, unhealthful, unwholesome, or unfit for human food; and said inspectors shall label, mark, stamp,

or tag as "Inspected and Condemned" all such products found unsound, unhealthful, and unwholesome, or which contain dyes, chemicals, preservatives, or ingredients which render such meat or meat food products unsound, unhealthful, unwholesome, or unfit for human food, and all such condemned meat food products shall be destroyed for food purposes, as hereinbefore provided, and the Secretary of Agriculture may remove inspectors from any establishment which fails to so destroy such condemned meat food porducts: *Provided*, That, subject to the rules and regulations of the Secretary of Agriculture, the provisions hereof in regard to preservatives shall not apply to meat food products for export to any foreign country and which are prepared or packed according to the specifications or directions of the foreign purchaser, when no substance is used in the preparation or packing thereof in conflict with the laws of the foreign country to which said article is to be exported; but if said article shall be in fact sold or offered for sale for domestic use or consumption, then this proviso shall not exempt said article from the operation of all the other provisions of this act.

[5] That when any meat or meat food product prepared for interstate or foreign commerce which has been inspected as hereinbefore provided and marked "Inspected and Passed" shall be placed or packed in any can, pot, tin, canvas, or other receptacle or covering in any establishment where inspection under the provisions of this act is maintained, the person, firm, or corporation preparing said product shall cause a label to be attached to said can, pot, tin, canvas, or other receptacle or covering, under the supervision of an inspector, which label shall state that the contents thereof have been "Inspected and Passed" under the provisions of this act; and no inspection and examination of meat or meat food products deposited or inclosed in cans, tins, pots, canvas, or other receptacle or covering in any establishment where inspection under the provisions of this act is maintained shall be deemed to be complete until such meat or meat food products have been sealed or inclosed in said can, tin, pot, canvas, or other receptacle or covering under the supervision of an inspector, and no such meat or meat food products shall be sold or offered for sale by any person, firm, or corporation in interstate or foreign commerce under any false or deceptive name; but established trade name or names which are usual to such products and which are not false and deceptive and which shall be approved by the Secretary of Agriculture are permitted.

[6] The Secretary of Agriculture shall cause to be made, by experts in sanitation or by other competent inspectors, such inspection of all slaughtering, meat-canning, salting, packing, rendering, or similar establishments in which cattle, sheep, swine, and goats are slaughtered and the meat and meat food products thereof are prepared for interstate or foreign commerce as may be necessary to inform himself concerning the sanitary conditions of the same, and to prescribe the rules and regulations of sanitation under which such establishments shall be maintained; and where the sanitary conditions of any such establishment are such that the meat or meat food products are rendered unclean, unsound, unhealthful, unwholesome, or otherwise unfit for human food, he shall refuse to allow said meat or meat food products to be labeled, marked, stamped, or tagged as "Inspected and Passed."

[7] That the Secretary of Agriculture shall cause an examination and inspection of all cattle, sheep, swine, and goats, and the food products thereof, slaughtered and prepared in the establishments hereinbefore described for the purposes of interstate or foreign commerce to be made during the nighttime as well as during the daytime when the slaughtering of said cattle, sheep, swine, and goats, or the preparation of said food products is conducted during the nighttime.

[8] That on and after October first, nineteen hundred and six, no person, firm, or corporation shall transport or offer for transportation, and no carrier of interstate or foreign commerce shall transport or receive for transportation from one State or Territory or the District of Columbia to any other State or Territory or the District of Columbia, or to any place under the jurisdiction of the United States or to any foreign country, any carcasses or parts thereof, meat, or meat food products thereof which have not been inspected, examined, and marked as "Inspected and Passed," in accordance with the terms of this act and with the rules and regulations prescribed by the Secretary of Agriculture: *Provided*, That all meat and meat food products on hand on October first, nineteen hundred and six, at establish-

ments where inspection has not been maintained, or which have been inspected under existing law, shall be examined and labeled under such rules and regulations as the Secretary of Agriculture shall prescribe, and then shall be allowed to be sold in interstate or foreign commerce.

[9] That no person, firm, or corporation, or officer, agent, or employee thereof, shall forge, counterfeit, simulate, or falsely represent, or shall without proper authority use, fail to use, or detach, or shall knowingly or wrongfully alter, deface, or destroy, or fail to deface or destroy, any of the marks, stamps, tags, labels, or other identification devices provided for in this act, or in and as directed by the rules and regulations prescribed hereunder by the Secretary of Agriculture, on any carcasses, parts of carcasses, or the food product, or containers thereof, subject to the provisions of this act, or any certificates in relation thereto, authorized or required by this act or by the said rules and regulations of the Secretary of Agriculture.

[10] That the Secretary of Agriculture shall cause to be made a careful inspection of all cattle, sheep, swine, and goats intended and offered for export to foreign countries at such times and places, and in such manner as he may deem proper, to ascertain whether such cattle, sheep, swine, and goats are free from disease.

[11] And for this purpose he may appoint inspectors who shall be authorized to give an official certificate clearly stating the condition in which such cattle, sheep, swine, and goats are found.

[12] And no clearance shall be given to any vessel having on board cattle, sheep, swine, or goats for export to a foreign country until the owner or shipper of such cattle, sheep, swine, or goats has a certificate from the inspector herein authorized to be appointed, stating that the said cattle, sheep, swine, or goats are sound and healthy, or unless the Secretary of Agriculture shall have waived the requirement of such certificate for export to the particular country to which such cattle, sheep, swine, or goats are to be exported.

[13] That the Secretary of Agriculture shall also cause to be made a careful inspection of the carcasses and parts thereof of all cattle, sheep, swine, and goats, the meat of which, fresh, salted, canned, corned, packed, cured, or otherwise prepared, is intended and offered for export to any foreign country, at such times and places and in such manner as he may deem proper.

[14] And for this purpose he may appoint inspectors who shall be authorized to give an official certificate stating the condition in which said cattle, sheep, swine, or goats, and the meat thereof, are found.

[15] And no clearance shall be given to any vessel having on board any fresh, salted, canned, corned, or packed beef, mutton, pork, or goat meat, being the meat of animals killed after the passage of this act, or except as hereinbefore provided for export to and sale in a foreign country from any port in the United States, until the owner or shipper thereof shall obtain from an inspector appointed under the provisions of this act a certificate that the said cattle, sheep, swine, and goats were sound and healthy at the time of inspection, and that their meat is sound and wholesome unless the Secretary of Agriculture shall have waived the requirements of such certificate for the country to which said cattle, sheep, swine, and goats or meats are to be exported.

[16] That the inspectors provided for herein shall be authorized to give official certificates of the sound and wholesome condition of the cattle, sheep, swine, and goats, their carcasses and products as herein described, and one copy of every certificate granted under the provisions of this act shall be filed in the Department of Agriculture, another copy shall be delivered to the owner or shipper, and when the cattle, sheep, swine, and goats or their carcasses and products are sent abroad, a third copy shall be delivered to the chief officer of the vessel on which the shipment shall be made.

[17] That no person, firm, or corporation engaged in the interstate commerce of meat or meat food products shall transport or offer for transportation, sell or offer to sell any such meat or meat food products in any State or Territory or in the District of Columbia or any place under the jurisdiction of the United States, other than in the State or Territory or in the District of Columbia or any place under the jurisdiction of the United States in which the slaughtering, packing, canning,

rendering, or other similar establishment owned, leased, operated by said firm, person, or corporation is located unless and until said person, firm, or corporation shall have complied with all of the provisions of this act.

[18] That any person, firm, corporation, or any officer or agent of any such person, firm, or corporation, who shall violate any of the provisions of this act shall be deemed guilty of a misdemeanor, and shall be punished on conviction thereof by a fine of not exceeding ten thousand dollars or imprisonment for a period of not more than two years, or by both such fine and imprisonment, in the discretion of the court.

[19] That the Secretary of Agriculture shall appoint from time to time inspectors to make examination and inspection of all cattle, sheep, swine, and goats, the inspection of which is hereby provided for, and of all carcasses and parts thereof, and of all meats and meat food products thereof, and of the sanitary conditions of all establishments in which such meat and meat food products hereinbefore described are prepared; and said inspectors shall refuse to stamp, mark, tag, or label any carcass or any part thereof, or meat food product therefrom, prepared in any establishment hereinbefore mentioned, until the same shall have actually been inspected and found to be sound, healthful, wholesome, and fit for human food, and to contain no dyes, chemicals, preservatives, or ingredients which render such meat food product unsound, unhealthful, unwholesome, or unfit for human food; and to have been prepared under proper sanitary conditions, hereinbefore provided for; and shall perform such other duties as are provided by this act and by the rules and regulations to be prescribed by said Secretary of Agriculture; and said Secretary of Agriculture shall, from time to time, make such rules and regulations as are necessary for the efficient execution of the provisions of this act, and all inspections and examinations made under this act shall be such and made in such manner as described in the rules and regulations prescribed by said Secretary of Agriculture not inconsistent with the provisions of this act.

[20] That any person, firm, or corporation, or any agent or employee of any person, firm, or corporation, who shall give, pay, or offer, directly or indirectly, to any inspector, deputy inspector, chief inspector, or any other officer or employee of the United States authorized to perform any of the duties prescribed by this act or by the rules and regulations of the Secretary of Agriculture any money or other thing of value, with intent to influence said inspector, deputy inspector, chief inspector, or other officer or employee of the United States in the discharge of any duty herein provided for, shall be deemed guilty of a felony and, upon conviction thereof, shall be punished by a fine not less than five thousand dollars nor more than ten thousand dollars and by imprisonment not less than one year nor more than three years; and any inspector, deputy inspector, chief inspector, or other officer or employee of the United States authorized to perform any of the duties prescribed by this act who shall accept any money, gift, or other thing of value from any person, firm, or corporation, or officers, agents, or employees thereof, given with intent to influence his official action, or who shall receive or accept from any person, firm, or corporation engaged in interstate or foreign commerce any gift, money, or other thing of value given with any purpose or intent whatsoever, shall be deemed guilty of a felony and shall, upon conviction thereof, be summarily discharged from office and shall be punished by a fine not less than one thousand dollars nor more than ten thousand dollars and by imprisonment not less than one year nor more than three years.

[21] That within the meaning of this act—

a) A "farmer" means any person or partnership chiefly engaged in producing agricultural products on whose farm the number of cattle, calves, sheep, lambs, swine, or goats is in keeping with the size of the farm or with the volume or character of the agricultural products produced thereon, but does not mean any person or partnership engaged in producing agricultural products who—

1) actively engages in buying or trading in cattle, calves, sheep, lambs, swine, or goats; or

2) actively engages, directly or indirectly, in conducting a business which includes the slaughter of cattle, calves, sheep, lambs, swine, or goats for food purposes; or

3) actively engages, directly or indirectly, in buying or selling meat or meat food products other than those prepared by any farmer on the farm; or

4) actively engages, directly or indirectly, in salting, curing, or canning meat, or in preparing sausage, lard, or other meat food products; or

5) slaughters, or permits any person to slaughter on his or their farm cattle, calves, sheep, lambs, swine, or goats which are not actually owned by him or them.

b) A "retail butcher" means any person, partnership, association, or corporation chiefly engaged in selling meat or meat food products to consumers only, except that the Secretary of Agriculture, at his discretion, may permit any retail butcher to transport in interstate or foreign commerce to consumers and meat retailers in any one week not more than five carcasses of cattle, twenty-five carcasses of calves, twenty carcasses of sheep, twenty-five carcasses of lambs, ten carcasses of swine, twenty carcasses of goats, or twenty-five carcasses of goat kids, or the equivalent of fresh meat therefrom, and to transport in interstate or foreign commerce to consumers only meat and meat food products which have been salted, cured, canned, or prepared as sausage, lard, or other meat food products, and which have not been inspected, examined, and marked as "Inspected and Passed" in accordance with the terms of the Meat-Inspection Act of March 4, 1907, and Acts supplemental thereto, and with the rules and regulations prescribed by the Secretary of Agriculture.

c) A "retail dealer" means any person, partnership, association, or corporation chiefly engaged in selling meat or meat food products to consumers only except that the Secretary of Agriculture, at his discretion, may permit any retail dealer to transport in interstate trade or foreign commerce to consumers and meat retailers in any one week not more than five carcasses of cattle, twenty-five carcasses of calves, twenty carcasses of sheep, twenty-five carcasses of lambs, ten carcasses of swine, twenty carcasses of goats, or twenty-five carcasses of goat kids, or the equivalent of fresh meat therefrom, and to transport in interstate or foreign commerce to consumers only meat and meat food products which have been salted, cured, canned, or prepared as sausage, lard, or other meat food products which have not been inspected, examined, and marked as "Inspected and Passed" in accordance with the terms of the Meat-Inspection Act of March 4, 1907, and Acts supplemental thereto, and with the rules and regulations prescribed by the Secretary of Agriculture.

That the provisions of the Meat-Inspection Act of March 4, 1907, requiring inspection to be made by the Secretary of Agriculture shall not apply to animals slaughtered by any farmer on the farm and sold and transported in interstate or foreign commerce, nor to retail butchers and retail dealers in meat and meat food products, supplying their customers: *Provided*, That all meat and meat food products derived from animals slaughtered by any farmer on the farm which are salted, cured, canned, or prepared into sausage, lard, or other meat food products at any place other than by the farmer on the farm upon which the animals were slaughtered shall not be transported in interstate or foreign commerce under the farmers' exemption herein provided, and all fresh meat and all farm-cured or prepared meat and meat products derived from animals slaughtered by any farmer on the farm which are to be used in interstate or foreign commerce shall be clearly marked with the name and address of the farmer on whose farm the animals were slaughtered: *Provided further*, That if any person shall sell or offer for sale or transportation for interstate or foreign commerce any meat or meat food products which are diseased, unsound, unhealthful, unwholesome, or otherwise unfit for human food, knowing that such meat food products are intended for human consumption, he shall be guilty of a misdemeanor and on conviction thereof shall be punished by a fine not exceeding $1,000 or by imprisonment for a period of not exceeding one year, or by both such fine and imprisonment: *And provided further*, That the Secretary of Agriculture is authorized to maintain the inspection in this Act provided for at any slaughtering, meat canning, salting, packing, rendering, or similar establishment notwithstanding this exception, and that the persons operating the same may be retail butchers and retail dealers or farmers: and where the Secretary of Agriculture shall establish such inspection then the provisions of this Act shall apply notwithstanding this exception.

CODE OF FEDERAL REGULATIONS OF THE UNITED STATES OF AMERICA

Title 9—Animals and Animal Products

CHAPTER I—BUREAU OF ANIMAL INDUSTRY

Subchapter A—Meat Inspection Regulations*

PART 1—DEFINITIONS

PART 2—SCOPE OF INSPECTION

PART 3—ORGANIZATION OF FORCE

PART 4—APPLICATIONS FOR INSPECTION OR EXEMPTION; RETAIL BUTCHERS, RETAIL DEALERS, AND FARMERS

§ 4.1 **Application for Inspection or Exemption.** (*a*) The proprietor or operator of each establishment of the kind specified in § 2.1 of this subchapter shall make application to the chief of division for inspection or for exemption from inspection.

b) The proprietor or operator of each establishment of the kind specified in § 2.3 of this subchapter shall make application to the chief of division for inspection.

c) Every application under this section shall be made on a form furnished by the division, Washington, D. C. In cases of change of ownership or change of location, a new application shall be made.

§ 4.2 **Inspection; Drawings, Information to be Furnished, Subsidiary Establishments, Notice of Grant of Inspection, False Statements.** (*a*) Triplicate copies of complete drawings, with specifications, consisting of floor plans showing the locations of such features as the principal pieces of equipment, floor drains, principal drainage lines, hand washing basins, and hose connections for clean-up purposes; roof plans; elevations; cross and longitudinal sections of the various buildings showing such features as principal pieces of equipment, heights of ceilings, conveyor rails, and character of floors and ceilings; and a plot plan showing such features as the limits of the plant's premises, locations in outline of buildings on the premises, cardinal points of the compass, and roadways and railroads serving the plant, properly drawn to scale, shall accompany applications for inspection. Applicants for inspection may request information from the chief of division concerning the requirements before submitting plans.

b) Each application shall specify the names, addresses, and forms of organization of subsidiaries for which inspection is requested to do any of the business described in §§ 2.1 or 2.3 of this subchapter.

c) Notice in writing shall be given to each applicant granted inspection, specifying the establishment to which the same applies.

d) The chief of division is hereby authorized to determine whether applications

* Parts 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, and 18 of the regulations are reprinted here in full. Only the part and section headings are given for Parts 1, 2, 3, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, and 29.

for inspection or for exemption from inspection shall be granted or refused, and to revoke his prior approval of any application if he determines that any false statement was made in such application.

§ 4.3 **Exemption.** (*a*) Retail butchers and retail dealers in product, supplying their customers as provided in the Meat-Inspection Act, upon making application, pursuant to § 4.1, may be exempted from inspection. To each one so exempted a numbered certificate of exemption shall be furnished. No certificate of exemption shall be issued unless all the premises on which the products are prepared and handled are maintained in a sanitary condition. Failure by certificate holders to maintain sanitary conditions or to conform to such of the regulations in this subchapter as apply to them shall be cause for withdrawal of exemption and the cancellation of certificates. Such exempted establishments shall conform to the same regulations as govern official establishments to the extent that such regulations are applicable, including but not limited to those regulations regarding labeling, the use of dyes, chemicals, and preservatives, and the prescribed treatment of pork to destroy trichinæ as required under Part 18 of this subchapter.

b) On request of the chief of division, or an employee designated by him, an exempted establishment shall furnish such information concerning its business and operations as has a bearing on the exemption of the establishment from inspection.

c) The chief of division is hereby authorized to withdraw exemption from any exempted establishment which fails to comply with any applicable provision of the Meat-Inspection Act or of the regulations made pursuant thereto.

§ 4.4 **Exemption; Holders of, Limited to Supplying Own Customers.** No establishment holding a certificate of exemption shall use the same for any purpose except to supply its own customers, as provided in the Meat-Inspection Act.

§ 4.5 **Shipments of Farm Dressed Meat.** The carcasses and products of animals slaughtered by any farmer on the farm: *Provided*, They can be identified as such and are sound, healthful, wholesome, and fit for human food, and otherwise meet the requirements of the applicable regulations in this subchapter, may be transported in interstate or foreign commerce under the provisions of § 25.11 of this subchapter. A farmer need not apply for exemption from inspection in order to procure the transportation of such carcasses and products.

§ 4.6 **Inspection for Violations.** The issuance of certificates of exemption shall be conditioned on the granting of permission by the holder thereof to inspectors to make inspections to ascertain whether any of the regulations in this subchapter have been violated. Inspectors shall make inspections to ascertain whether any of the regulations in this subchapter applying to retail butchers, retail dealers, farmers, or other persons have been violated.

PART 5—OFFICIAL NUMBERS AND INAUGURATION OF INSPECTION

§ 5.1 **Official Numbers; Subsidiary Establishments.** (*a*) To each establishment granted inspection an official number shall be assigned. Such number shall be used to identify all inspected and passed products prepared in the establishment. More than one number shall not be assigned to an establishment.

b) Two or more official establishments under the same ownership or control may be granted the same official number, provided a serial letter is added in each case to identify each establishment and the products thereof.

c) When inspection has been granted to a person at an establishment, it shall not be granted to any other person at the same establishment, except that a subsidiary of the grantee, doing any of the business described in § 2.1 of this subchapter may apply for and receive inspection.

§ 5.2 **Separation of Official from Unofficial Establishment.** (*a*) Each official establishment shall be separate and distinct from any other official establishment, from any unofficial establishment in which any product is handled, and from any other unofficial establishment at the discretion of the chief of division.

b) Inspection shall not be inaugurated in any building any part of which is used as living quarters, unless the part for which inspection is requested is separated from such quarters by floors, walls, and ceilings of solid concrete, brick, or similar

material, and the floors, walls, and ceilings are without opening that directly or indirectly communicates with any part of the building used as living quarters.

§ **5.3 Sanitation and Adequate Facilities.** Inspection shall not be begun if an establishment is not in a sanitary condition nor unless the establishment agrees to maintain such condition and provides adequate facilities for conducting such inspection.

§ **5.4 Inauguration of Inspection.** When an application for inspection is granted, the inspector in charge shall, at or prior to the inauguration of inspection, inform the proprietor or operator of the establishment of the requirements of these regulations. If the establishment, at the time inspection is inaugurated, contains any product which has not theretofore been inspected, passed, and marked in compliance with the regulations in this subchapter, the identity of the same shall be maintained, and it shall not be transported or offered for transportation in interstate or foreign commerce, or otherwise dealt with as inspected and passed under the regulations in this subchapter. The establishment shall adopt and enforce all necessary measures, and shall comply with all such directions as the inspector in charge may prescribe, for carrying out the purposes of this section.

§ **5.5 Withdrawal of Inspection for Violations of Regulations.** The chief of division is hereby authorized to withdraw inspection from any official establishment which fails to comply with any provision of the Meat-Inspection Act or of the regulations made pursuant thereto.

§ **5.6 Reports of Violations of Regulations.** Inspectors and other division employees shall report to the inspector in charge all violations and failures under § 5.5 of which they have knowledge, and the inspector in charge shall report the same to the chief of division.

PART 6—ASSIGNMENT OF DIVISION EMPLOYEES

§ **6.1 Designation of Inspector in Charge and Assistants.** The chief of division shall designate an inspector in charge of the inspection at each official station, and assign to said inspector such assistants as may be necessary.

§ **6.2 Division Employees to Have Access to Establishments at All Times.** For the purpose of any examination or inspection necessary to enforce any of the provisions of the regulations contained in this subchapter, division employees shall have access at all times, by day or night, whether the establishment is operated or not, to every part of any official establishment to which they are assigned.

§ **6.3 Badge as Identification of Inspectors.** Each division employee will be furnished with a numbered official badge, which he shall not allow to leave his possession, and which he shall wear in such manner and at such times as the chief of the division may prescribe. This badge shall be sufficient identification to entitle him to admittance at all regular entrances and to all parts of the establishment and premises to which he is assigned.

§ **6.4 Assignment of Inspectors Where Members of Family Employed; Soliciting Employment.** Except as specifically authorized by the chief of division, no division employee shall be detailed for duty at an establishment where any member of his family is employed by the establishment, nor shall any inspector in charge or other employee acting in a supervisory capacity be continued on duty at an official station where any member of his family is employed by any establishment under his jurisdiction. Division employees are forbidden to solicit, for any person, employment at any official establishment, or by any officer, manager, or employee thereof.

PART 7—FACILITIES FOR INSPECTION

§ **7.1 Facilities for Division Employees.** Furnished office room, including light, heat, and janitor service, shall be provided by official establishments, rent free, for the exclusive use for official purposes of the inspector and other division employees assigned thereto. The room or rooms set apart for this purpose shall meet with the approval of the inspector in charge and shall be conveniently located, properly ventilated, and provided with lockers suitable for the protection

and storage of division supplies and with facilities suitable for division employees to change clothing. Laundry service for inspectors' outer work clothing shall be provided by establishments.

§ **7.2 Hours of Operation of Official Establishments.** Each official establishment shall inform the inspector in charge, or his assistant, when work in each department has been concluded for the day, and of the day and hour when work will be resumed therein. Whenever any product is to be overhauled or otherwise handled in an official establishment during unusual hours, the establishment shall, a reasonable time in advance, notify the inspector in charge, or his assistant, of the day and hour when such work will be commenced, and such articles shall not be so handled except after such notice has been given. No department of an official establishment shall be operated except under the supervision of a division employee. All slaughtering of animals and preparation of products shall be done within reasonable hours, and with reasonable speed, the facilities of the establishment being considered. No shipment of any product shall be made from an official establishment until after due notice has been given to the inspector in charge or his assistant.

§ **7.3 Designation of Days and Hours of Operation by Inspector in Charge.** When one inspector is detailed to conduct the work at two or more official establishments where few animals are slaughtered or where but a small quantity of any product is prepared, the inspector in charge may designate the hours of the day and the days of the week during which such establishments may be operated.

§ **7.4 Overtime Work of Meat Inspection Employees.** The management of an official establishment desiring to work under conditions which will require the services of an employee of the Division on any Saturday, Sunday, or holiday, or for more than 8 hours on any day, including Monday through Friday, shall, sufficiently in advance of the period of overtime, request the inspector in charge or his assistant to furnish inspection service during such overtime period, and shall pay the Secretary of Agriculture therefor $2.40 per man-hour for each hour of inspection service so furnished. It will be administratively determined from time to time which days constitute holidays.

§ **7.5 Facilities and Conditions to be Provided by Establishment.** When required by the chief of the division or the inspector in charge, the following facilities and conditions, and such others as may be essential to efficient conduct of inspection and maintenance of sanitary conditions, shall be provided by each official establishment:

a) Satisfactory pens, equipment, and assistants for conducting ante-mortem inspection and for separating, marking, and holding apart from passed animals those marked "U. S. suspect" and those marked "U. S. condemned." Pens, alleys, and runways shall be paved, drained, and supplied with adequate hose connections for clean-up purposes. Sufficient light shall be provided for the inspection.

b) Sufficient natural light and abundant artificial light at all places and such times of the day when natural light may not be adequate for proper conduct of inspection. Rooms shall be kept sufficiently free of steam and vapors for inspection to be properly made. Equipment of substances which generate gases or odors shall not be used except as specifically permitted by the chief of division.

c) Racks, receptacles, or other suitable devices for retaining such parts as the head, tongue, tail, thymus gland, and viscera, and all parts and blood to be used in the preparation of meat food products or medical products, until after the post-mortem examination is completed, in order that they may be identified in case of condemnation of the carcass; equipment, trucks, and receptacles for the handling of viscera of slaughtered animals so as to prevent contact with the floor; trucks, racks, marked receptacles, tables, or other necessary equipment for the separate and sanitary handling of carcasses or parts passed for cooking.

d) Tables, benches, and other equipment on which inspection is performed, of such design, material, and construction as to enable division employees to conduct their inspection in a ready, efficient, and cleanly manner.

e) Watertight metal trucks or receptacles for holding and handling diseased carcasses and parts, so constructed as to be readily cleaned; such trucks or receptacles to be marked in a conspicuous manner with the phrase "U. S. condemned"

in letters not less than 2 inches high and, when required by the inspector in charge, to be equipped with facilities for locking or sealing.

f) Adequate arrangements, including liquid soap and cleansers, for cleansing and disinfecting hands, for sterilizing all implements used in dressing diseased carcasses, floors, and such other articles and places as may be contaminated by diseased carcasses or otherwise.

g) In establishments in which slaughtering is done, rooms, compartments, or specially prepared open places, to be known as "final inspection places," at which the final inspection of retained carcasses may be conducted. Competent assistants for handling retained carcasses and parts shall be provided by the establishment. Final inspection places shall be adequate in size and their rail arrangement and other equipment shall be sufficient to prevent carcasses and parts, passed for food or cooking, from being contaminated by contact with condemned carcasses or parts. They shall be equipped with hot water, lavatory, sterilizer, tables, and other equipment required for ready, efficient, and sanitary conduct of the inspection. The floors shall be of such construction as to facilitate the maintenance of sanitary conditions and shall have proper drainage connections, and when the final inspection place is part of a larger floor, it shall be separated by a curb, railing, or otherwise.

h) Rooms, compartments, and receptacles in which carcasses and product may be held for further inspection. These shall be in such number and in such locations as the needs of the inspection in the establishment may require. They shall be equipped for secure locking and shall be held under locks furnished by the Department, the keys of which shall not leave the custody of division employees. Every such room, compartment, or receptacle shall be marked conspicuously with the phrase "U. S. retained" in letters not less than 2 inches high. Rooms or compartments for these purposes shall be secure and susceptible of being kept clean, including a sanitary disposal of the floor liquids.

i) Adequate facilities, including denaturing materials, for the proper disposal of condemned articles in accordance with the regulations in this subchapter. Tanks or other rendering equipment which, under the regulations in this subchapter, must be sealed, shall be properly equipped for sealing as may be specified by the chief of division.

j) Docks and receiving rooms, to be designated by the establishment, with the approval of the inspector in charge, for the receipt and inspection of all products as provided in § 18.4 of this subchapter.

k) Suitable lockers in which brands bearing the inspection legend shall be kept when not in use. All such lockers shall be equipped for locking with locks to be supplied by the Department, the keys of which shall not leave the custody of division employees.

§ **7.6 Inspectors to Furnish Implements and Maintain Hands and Implements in Sanitary Condition.** Inspectors shall furnish their own work clothing and implements, such as knives, steels, flashlights, and triers, for conducting inspection and shall cleanse their hands and implements as prescribed by § 8.8 (*c*) of this subchapter.

PART 8—SANITATION

§ **8.1 Examination and Specifications for Equipment and Sanitation Prior to Granting Inspection.** Prior to the inauguration of inspection, an examination of the establishment and premises shall be made by a division employee and the requirements for sanitation and the necessary facilities for inspection specified.

§ **8.2 Drawings and Specifications to be Furnished in Advance of Construction.** Triplicate copies of drawings and specifications, complete as contemplated in § 4.2 of this subchapter, for remodeling plants of official establishments and for new structures shall be submitted to the chief of division and approval obtained for the plans in advance of construction.

§ **8.3 Establishments; Sanitary Condition; Requirements.** (*a*) Official establishments, establishments at which market inspection is conducted, and premises on or in which any product is prepared or handled by or for persons to whom certificates of exemption have been issued, shall be maintained in sanitary condition,

and to this end the requirements of paragraphs (*b*) to (*h*), inclusive, of this section shall be complied with.

b) There shall be abundant light, both natural and artificial, of good quality and well distributed, and sufficient ventilation for all rooms and compartments to insure sanitary condition.

c) There shall be an efficient drainage and plumbing system for the establishment and premises, and all drains and gutters shall be properly installed with approved traps and vents.

d) (1) The water supply shall be ample, clean, and potable, with adequate facilities for its distribution in the plant and its protection against contamination and pollution. Every establishment shall make known and, whenever required, shall afford opportunity for inspection of the source of its water supply, the storage facilities, and the distribution system. Equipment using potable water shall be so installed as to prevent back-siphonage into the potable water system. Nonpotable water is permitted only in those parts of official establishments where no edible product is handled or prepared, and then only for limited purposes such as on ammonia condensers not connected with the potable water supply, in vapor lines serving inedible product rendering tanks, in connection with equipment used for hashing and washing inedible products preparatory to tanking, and in sewer lines for moving heavy solids in the sewage. Nonpotable water is not permitted for washing floors, areas, or equipment involved in trucking materials to and from edible products departments, nor is it permitted in hog scalding vats, dehairing machines, or vapor lines serving edible product rendering equipment, or for clean-up of shackling pens, bleeding areas, or runways within the slaughtering department. In all cases, nonpotable water lines shall be clearly identified and shall not be cross-connected with the potable water supply unless this is necessary for fire-protection and such connection is of a type with an adequate break to assure against accidental contamination, and is approved by local authorities and by the chief of division.

2) Inspectors in charge may permit the re-use of water in vapor lines leading from deodorizers used in the preparation of lard and similar edible product and in equipment used for the chilling of canned product after retorting, provided the re-use is for the identical original purpose and the following precautions are taken to protect the water that is re-used:

i) All pipe lines, reservoirs, tanks, cooling towers, and like equipment employed in handling the re-used water are so constructed and installed as to facilitate their cleaning and inspection.

ii) Complete draining and disposal of the re-used water, effective cleaning of the equipment, and renewal with fresh potable water is accomplished at such intervals as may be necessary to assure an acceptable supply of water for the purpose intended.

iii) Effective chlorination (not less than approximately 1 part per million of residual chlorine at any point within the cooling system) of the re-used water utilized for cooling canned product is maintained but with the understanding that chlorination alone is not to be relied upon entirely or to be accepted in lieu of the requirements listed in subdivisions (i) and (ii) of this subparagraph.

3) An ample supply of water at not less than 180° F. shall be furnished and used for the cleaning of inspection equipment and other equipment, floors, walls, and the like, which are subject to contamination by the dressing or handling of diseased carcasses, their viscera and parts. Whenever necessary to determine compliance with this requirement, conveniently located thermometers shall be installed to show the temperature of the water at the point of use.

4) Hot water for cleaning rooms and equipment other than those mentioned in subparagraph (3) of this paragraph shall be delivered under pressure to sufficient convenient outlets and shall be of such temperature as to accomplish a thorough clean-up.

e) The floors, walls, ceilings, partitions, posts, doors, and other parts of all structures shall be of such materials, construction, and finish as will make them susceptible of being readily and thoroughly cleaned. The floors shall be kept

watertight. The rooms and compartments used for edible products shall be separate and distinct from those used for inedible products.

f) The rooms and compartments in which any product is prepared or handled shall be free from dust and from odors from dressing and toilet rooms, catchbasins, hide cellars, casing rooms, inedible tank and fertilizer rooms, and livestock pens.

g) Every practicable precaution shall be taken to exclude flies, rats, mice, and other vermin from establishments. The use of poisons for any purpose in rooms or compartments where any unpacked product is stored or handled is forbidden, except under such restrictions and precautions as the chief of division may prescribe. The use of bait poisons in hide cellars, inedible compartments, outbuildings, or similar places, or in storerooms containing canned or tierced products is not forbidden but only those approved by the chief of division may be used. So-called rat viruses shall not be used in any part of an establishment or the premises thereof.

h) Dogs and cats shall be excluded from establishments.

§ 8.4 **Sanitary Facilities and Accommodations; Specific Requirements.** Adequate sanitary facilities and accommodations shall be furnished by every official establishment. Of these the following are specifically required:

a) Dressing rooms, toilet rooms, and urinals shall be sufficient in number, ample in size, and conveniently located. The rooms shall be provided with windows to admit direct, natural light and shall have adequate facilities for artificial light. They shall be properly ventilated, and meet all requirements as to sanitary construction and equipment. They shall be separate from the rooms and compartments in which products are prepared, stored, or handled. Where both sexes are employed, separate facilities shall be provided.

b) Modern lavatory accommodations, including running hot and cold water, soap, towels, etc. These shall be placed in or near toilet and urinal rooms and also at such other places in the establishment as may be essential to assure cleanliness of all persons handling product.

c) Toilet soil lines shall be separate from house drainage lines to a point outside the buildings and drainage from toilet bowls and urinals shall not be discharged into a grease catchbasin.

d) Properly located facilities for cleansing and disinfecting utensils and hands of all persons handling any product.

§ 8.5 **Equipment to be Easily Cleaned; That for Inedible Products to be Marked.** Equipment and utensils used for preparing, processing, and otherwise handling any product shall be of such materials and construction as will make them susceptible of being readily and thoroughly cleaned and such as will insure strict cleanliness in the preparation and handling of all products. So far as is practicable, such equipment shall be made of metal or other impervious material. Trucks and receptacles used for inedible materials shall be of similar construction and shall bear some conspicuous and distinctive mark, and shall not be used for handling edible products.

§ 8.6 **Scabbards for Knives.** Scabbards and similar devices for the temporary retention of knives, steels, triers, etc., by workers and others at inspected establishments shall be constructed of rust-resisting metal or other impervious material, shall be of a type that may be readily cleaned, and shall be kept clean.

§ 8.7 **Rooms, Compartments, etc., to be Clean and Sanitary.** Rooms, compartments, places, equipment, and utensils used for preparing, storing, or otherwise handling any product, and all other parts of the establishment, shall be kept clean and in sanitary condition. There shall be no handling or storing of materials which create an objectionable condition in rooms, compartments, or places where product is prepared, stored, or otherwise handled.

§ 8.8 **Operations, Procedures, Rooms, Clothing, Utensils, etc., to be Clean and Sanitary.** (*a*) Operations and procedures involving the preparation, storing, or handling of any product shall be strictly in accord with cleanly and sanitary methods.

b) Rooms and compartments in which inspections are made and those in which animals are slaughtered or any product is processed or prepared shall be kept sufficiently free of steam and vapors to enable division employees to make inspections and to insure cleanly operations. The walls, ceilings, and overhead structures

of rooms and compartments in which product is prepared, handled, or stored shall be kept reasonably free from moisture.

c) Butchers and others who dress or handle diseased carcasses or parts shall, before handling or dressing other carcasses or parts, cleanse their hands with liquid soap and hot water, and rinse them in clean water. Implements used in dressing diseased carcasses shall be thoroughly cleansed in boiling water, or in a prescribed disinfectant followed by rinsing in clean water. The employees of the establishment who handle any product shall keep their hands clean, and in all cases after visiting the toilet rooms or urinals shall wash their hands before handling any product or implements used in the preparation of product.

d) Aprons, frocks, and other outer clothing worn by persons who handle any product shall be of material that is readily cleansed and only clean garments shall be worn.

e) Such practices as spitting on whetstones; spitting on the floor; placing skewers, tags, or knives in the mouth; inflating lungs or casings, or testing with air from the mouth such receptacles as tierces, kegs, casks, and the like, containing or intended as containers of any product, are prohibited. Only mechanical means may be used for testing. Care shall be taken to prevent the contamination of products with perspiration, hair, cosmetics, medicaments and the like.

§ **8.9 Protective Coverings for Product.** Inspectors in charge shall require the use of such protective coverings for product as it is distributed from official establishments as will afford adequate protection for the product against dust, dirt, insects, and the like, considering the means intended to be employed in transporting the product from the establishment.

§ **8.10 Slack Barrels and Similar Containers and Vehicles and Cars for Product; Paper in Contact with Product.** (*a*) When necessary to avoid contamination of product with wood splinters and the like, slack barrels and similar containers, and vehicles and cars shall be lined with suitable material of good quality before packing.

b) Slack barrels and similar containers and vehicles and cars in which any product is transported shall be kept in a clean and sanitary condition.

c) Paper used for covering or lining slack barrels and similar containers and vehicles and cars shall be of a kind which does not tear during use but remains intact when moistened by the product and does not disintegrate.

§ **8.11 Burlap Wrapping for Meat; Meat Wrapped in, to be Previously Wrapped in Paper or Cloth.** Since burlap used without any other material as a wrapping for meat deposits lint on the meat and does not sufficiently protect it from outside contamination, the use of burlap as a wrapping for meat will not be permitted unless the meat is first wrapped with a good grade of paper or cloth of a kind which will prevent contamination with lint or other foreign matter.

§ **8.12 Second-hand Tubs, Barrels, Other Containers, and Tank Cars; Inspection and Cleaning.** (*a*) Second-hand tubs, barrels, and boxes intended for use as containers of any product shall be inspected when received at the establishment and before they are cleaned. Those showing evidence of misuse rendering them unfit to serve as containers for food products shall be rejected. The use of those showing no evidence of previous misuse may be allowed after they have been thoroughly and properly cleaned. Steaming, after thorough scrubbing and rinsing, is essential to cleaning tubs and barrels.

b) Interiors of tank cars about to be used for the transportation of any product shall be carefully inspected for cleanliness even though the last previous content was edible. Lye and soda solutions used in cleaning must be thoroughly removed by rinsing with clean water. In their examinations division employees shall enter the tank with a light and examine all parts of the interior.

§ **8.13 Inedible Operating and Storage Rooms; Outer Premises, Docks, Driveways, Approaches, Pens, Alleys, etc.; Fly-breeding Material; Nuisances.** All operating and storage rooms and departments of official establishments used for inedible materials shall be maintained in acceptably clean condition. The outer premises of every official establishment, embracing docks and areas where cars and vehicles are loaded, and the driveways, approaches, yards, pens, and alleys, shall be properly paved and drained and kept in clean and orderly condition. All

catchbasins on the premises shall be of such construction and location and shall be given such attention as will insure their being kept in acceptable condition as regards odors and cleanliness. Catchbasins shall not be located in departments where product is prepared, handled, or stored. The accumulation on the premises of establishments of any material in which flies may breed, such as hog hair, bones, paunch contents, or manure, is forbidden. No nuisance shall be allowed in any establishment or on its premises.

§ 8.14 **Employment of Diseased Persons.** No establishment shall employ, in any department where any product is handled or prepared, any person affected with tuberculosis or other communicable disease in a transmissible stage.

§ 8.15 **Tagging Insanitary Equipment, etc.** When necessary, division employees shall attach a "U. S. rejected" tag to any equipment or utensil which is unclean or the use of which would be in violation of the regulations in this subchapter. No equipment or utensil so tagged shall again be used until made acceptable. Such tag so placed shall not be removed by anyone other than a division employee.

PART 9—ANTE-MORTEM INSPECTION

§ 9.1 **Ante-mortem Inspection in Pens of Official Establishments; Suspects.** (*a*) An ante-mortem examination and inspection shall be made of all cattle, sheep, swine, and goats about to be slaughtered in an official establishment before their slaughter shall be allowed. Such inspection shall be made on the day of slaughter.

b) Such ante-mortem inspection shall be made in pens on the premises of the establishment in which the animals are about to be slaughtered. When the holding pens of an official establishment are located in a public stock yard and are reserved for the exclusive use of the establishment, such pens shall be regarded as part of the premises of that establishment and the establishment shall be responsible therein for all requirements of this subchapter.

c) Every animal required to be marked as a suspect on ante-mortem inspection in the pens of an official establishment shall be set apart, and, except as hereinafter provided, shall be slaughtered separately from other animals at that establishment unless disposed of as otherwise provided in this part.

§ 9.2 **Animals Suspected of being Diseased; Disposition of on Post-mortem Inspection or Otherwise; Marking Suspects; Temperatures Where Disease Suspected.** (*a*) Any animal which, on ante-mortem inspection, does not plainly show, but is suspected of being affected with, any disease or condition that, under this subchapter, may cause condemnation of the carcass on post-mortem inspection, and any animal which shows, on ante-mortem inspection, any disease or condition that, under this subchapter, would cause condemnation of only part of the carcass on post-mortem inspection, shall be so marked as to retain its identity as a suspect until final post-mortem inspection, when the carcass shall be marked and disposed of as provided elsewhere in this subchapter, or until disposed of as otherwise provided for in this part.

b) All animals required by this subchapter to be treated as suspects, or to be marked as suspects, or to be marked so as to retain their identity as suspects, shall be marked by or under the supervision of a division employee "U. S. suspect," or with other distinctive mark or marks to indicate that they are suspects as the chief of division may adopt, such as provided under § 9.11. No such mark shall be removed except by a division employee.

c) Each animal marked "U. S. suspect" on ante-mortem inspection, and animals treated as suspects such as provided under § 9.11, when presented for slaughter shall be accompanied with a Form MI 402–2, on which shall be recorded the suspect tag number and any other identifying tag numbers present and a brief description of the animal and of the disease or condition for which the animal was classed as a suspect, including its temperature when the temperature of such animal might have a bearing on the disposition of the carcass on post-mortem inspection.

d) Any swine having a temperature of 106°F. or higher and any cattle, sheep, or goats having a temperature of 105°F. or higher shall be marked "U. S. condemned." In case of doubt as to the cause of the high temperature, or when for

other reasons such action appears warranted, any such animals may be held for a reasonable time, under the supervision of a division employee, for further observation and taking of temperature before final disposition of such animals is determined.

e) When any animal tagged "U. S. suspect" is released for any purpose or reason, as provided in this part, the tag shall be removed by a division employee and his action reported to the inspector in charge.

§ 9.3 **Marking Animals "U. S. Condemned" Found Diseased or in Dying Condition.** (*a*) All animals plainly showing on ante-mortem inspection any disease or condition that, under this subchapter, would cause condemnation of their carcasses on post-mortem inspection shall be marked "U. S. condemned" and disposed of in accordance with § 9.16.

b) Animals received for slaughter and found in a dying condition on premises of an official establishment shall be marked "U. S. condemned" and disposed of in accordance with § 9.16.

c) Reactors to the tuberculin test, required by this section to be condemned, should be autopsied and the findings made the subject of a special report.

d) Any animal found in a comatose or semicomatose condition or affected with any condition not otherwise covered in this part which would not warrant release of the animal for slaughter for food shall be marked "U. S. condemned" and disposed of in accordance with § 9.16 except that such animal may be set apart and held for further observation or treatment under division or other responsible official supervision.

§ 9.4 **Cripples and Downers; Boars and Stags.** (*a*) All seriously crippled animals and animals commonly termed "downers," if not marked "U. S. condemned," as required elsewhere in this part, shall be marked and treated as suspects in accordance with § 9.2.

b) All boars which are sexually mature, and swine stags which show evidence of recent castration, shall be marked and treated as suspects in accordance with § 9.2.

§ 9.5 **Immature Animals.** Animals which are offered for ante-mortem inspection under this part, and which are regarded as immature, shall be marked "U. S. suspect," and, if slaughtered, the disposition of their carcases shall be determined by the post-mortem findings in connection with the ante-mortem conditions. If not slaughtered as suspects, such animals shall be held under division or other responsible official supervision, and after sufficient development may be released for slaughter, or may be released for any other purpose, provided they have not been exposed to any infectious or contagious disease.

§ 9.6 **Animals Showing Symptcms of Rabies, Tetanus, Parturient Paresis, or Railroad Sickness.** All animals showing on ante-mortem inspection symptoms of rabies, tetanus, parturient paresis, or railroad sickness shall be marked "U. S. condemned" and disposed of in accordance with § 9.16, except that cattle showing symptoms of parturient paresis or railroad sickness may be set apart and held for treatment under division or other responsible official supervision. If, at the expiration of the treatment period, the animal upon examination is found to be free from disease, it may be released for any purpose in accordance with § 9.16.

§ 9.7 **Hog Cholera; Swine Injected with Hog-cholera Virus.** (*a*) All hogs plainly showing on ante-mortem inspection that they are affected with hog cholera shall be marked "U. S. condemned" and disposed of in accordance with § 9.16.

b) If a hog has a temperature of 106°F. or higher, and is of a lot in which there are symptoms of hog cholera, in case of doubt as to the cause of the high temperature, after being marked for identification, it may be held for a reasonable time, under the supervision of a division employee for further observation and taking of temperature. Any hog so held shall be reinspected on the day it is slaughtered. If, upon such reinspection, or when not held for further observation and taking of temperature, then on the original inspection, the hog has a temperature of 106°F. or higher, it shall be condemned and disposed of in accordance with § 9.16.

c) All hogs, even though not themselves marked as suspects, which are of lots one or more of which have been condemned or marked as suspects for hog cholera,

shall, so far as possible, be slaughtered separately and apart from all other animals passed on ante-mortem inspection.

d) A hog suspected of being affected with hog cholera may be set apart and held for treatment under division or other responsible official supervision. If at the expiration of the treatment period the animal, upon examination, is found to be free from disease, it may be released for any purpose, including slaughter.

e) Swine, other than hyperimmune swine, shall be condemned on ante-mortem inspection if offered for slaughter within 28 days after injection with hog-cholera virus.

f) Swine, other than hyperimmune swine, offered for slaughter after 28 days following injection with hog-cholera virus shall be given ante-mortem inspection in conformity with this subchapter without reference to the injected virus.

g) Hyperimmune swine shall be condemned on ante-mortem inspection if offered for slaughter within 10 days after hyperimmunization.

h) Hyperimmune swine offered for slaughter after 10 days following hyperimmunization shall be given ante-mortem inspection in conformity with this subchapter without reference to the injected virus.

§ **9.8 Epithelioma of the Eye of Cattle.** (*a*) Any animal found on ante-mortem inspection to be affected with epithelioma of the eye and of the orbital region in which the eye has been destroyed or obscured by neoplastic tissue and which shows extensive infection, suppuration, and necrosis, usually accompanied with foul odor, or any animal affected with epithelioma of the eye or of the orbital region which, regardless of extent, is accompanied with cachexia shall be marked "U. S. condemned" and disposed of in accordance with § 9.16.

b) Any animal found on ante-mortem inspection to be affected with epithelioma of the eye or of the orbital region to a lesser extent than in (*a*) shall be marked "U. S. suspect" and disposed of as provided in this subchapter.

§ **9.9 Animals Affected with Anthrax; Cleaning and Disinfection of Infected Livestock Pens and Driveways.** (*a*) Any animal found on ante-mortem inspection to be affected with anthrax shall be marked "U. S. condemned" and disposed of in accordance with § 9.16.

b) No animal of a lot in which anthrax is found on ante-mortem inspection shall be presented for post-mortem inspection until it has been determined by a careful ante-mortem inspection that no infected animal remains in the lot. Apparently healthy animals other than hogs shall be held as provided for in paragraph (*c*) of this section. If desired, all apparently healthy animals of the lot may be segregated and held for treatment by a competent veterinarian under division or other responsible official supervision. No anthrax vaccine (live organisms) shall be used on the premises of an official establishment.

c) Apparently healthy animals of a lot of cattle, calves, sheep, or goats in which anthrax is detected, and animals which have been treated with anthrax biologicals which do not contain living anthrax organisms, shall not be presented for post-mortem inspection in less than 21 days following the last treatment or the last death. Treatment with anthrax vaccine (live organisms) must be elsewhere than on the official premises and subject to the conditions stated in paragraph (*d*) of this section.

d) Animals which have been injected with anthrax vaccines (live organisms) within six weeks, and those bearing evidence of reaction to such treatment, such as inflammation, tumefaction, or edema at the site of the injection, shall be condemned on ante-mortem inspection, or such animals may be held under division or other responsible official supervision until the expiration of the 6-week period and the disappearance of any reaction to the treatment.

e) When animals are found on ante-mortem inspection to be affected with anthrax, the cleaning and disinfection of exposed livestock pens and driveways of the official establishment shall consist of promptly and thoroughly removing and burning all straw, litter, and manure. This should be followed immediately by a thorough disinfection of the exposed premises by soaking the ground, fences, gates, and all exposed material with a 5 per cent solution of sodium hydroxide or commercial lye prepared as outlined in § 10.9 (*c*) (1) of this subchapter, or other disinfectant approved by the chief of division specifically for this purpose.

§ **9.10 Cattle Affected with Anasarca or Generalized Edema.** (*a*) All cattle found on ante-mortem inspection to be affected with anasarca in advanced stages and characterized by an extensive and generalized edema shall be marked "U. S. condemned" and disposed of in accordance with § 9.16.

b) Cattle found on ante-mortem inspection to be affected with anasarca to a lesser extent than in paragraph (*a*) of this section shall be marked "U. S. suspect" and disposed of as provided elsewhere in this subchapter.

c) An animal suspected of being affected with anasarca may be set apart and held for treatment under division or other responsible official supervision. If at the expiration of the treatment period the animal upon examination is found to be free from disease, it may be released for any prupose.

§ **9.11 Tuberculin-test Reactors.** Animals which are known to have reacted to the tuberculin test and which are to be slaughtered at an official establishment shall be marked and treated as suspects in accordance with § 9.2, except that animals bearing an official "USBAI Reacted" or similar State reactor tag should not be tagged "U. S. suspect."

§ **9.12 Swine Erysipelas.** (*a*) All hogs plainly showing on ante-mortem inspection that they are affected with acute swine erysipelas shall be marked "U. S. condemned" and disposed of in accordance with § 9.16.

b) All hogs suspected on ante-mortem inspection of being affected with swine erysipelas shall be marked and treated as suspects and disposed of in accordance with this subchapter.

c) A hog suspected of being affected with swine erysipelas may be set apart and held under division or other responsible official supervision for treatment. If at the expiration of the treatment period the animal upon examination is found to be free from disease, it may be released for any purpose.

§ **9.13 Pregnancy or Recent Parturition.** The slaughter of an animal which has been marked as a suspect on account of advanced pregnancy or on account of having recently given birth to young, and which has not been exposed to any infectious or contagious disease, is not required. Such animal, together with its young, may be released for breeding or dairy purposes, and when released shall be removed promptly from the stockyards or premises of the establishment where inspected. Such animals may be held at the establishment for a period of not less than 10 days. At the completion of this holding period if the animals appear normal and have not been exposed to contagious or infectious disease, they may be released for slaughter or for any other purpose.

§ **9.14 Vaccine Animals.** Vaccine animals with unhealed lesions of vaccinia, accompanied with fever, which have not been exposed to any other infectious or contagious disease, are not required to be slaughtered and may be released for removal from the premises.

§ **9.15 Emergency Slaughter; Inspection Prior to.** In all cases of emergency slaughter, except as provided in § 11.29 of this subchapter, the animals shall be inspected immediately before slaughter, whether theretofore inspected or not. When the necessity for emergency slaughter exists, the establishment shall notify the inspector in charge or his assistant so that such inspection may be made.

§ **9.16 Disposition of Condemned Animals.** Except as otherwise provided in this part, animals marked "U. S. condemned" shall be killed by the official establishment, if not already dead, and shall not be taken into an establishment to be slaughtered or dressed; nor shall they be conveyed into any department of the establishment used for edible products; but they shall be disposed of and tanked in the manner provided for condemned carcasses in Part 14 of this subchapter. The "U. S. condemned" tag shall not be removed from, but shall remain on, the carcass until it goes into the tank at which time, it may be removed by a division employee only. The number of such tag shall be reported to the inspector in charge by the inspector who affixed it, and also by the inspector who supervised the tanking of the carcass. Any animal condemned on account of hog cholera, swine erysipelas, vesicular exanthema, vesicular stomatitis, railroad sickness, parturient paresis, anasarca, or inflammatory condition including pneumonia, enteritis, and peritonitis, may be set apart and held for treatment under division or other responsible official supervision. The "U. S. condemned" tag will be removed by a division

employee either when the animal is released to a responsible official for treatment, or following treatment under division supervision if the animal is found to be free from disease. When an animal under the provisions of these regulations is to be released for a purpose other than slaughter, the official establishment or the owner of the animal shall first obtain permission for the movement of such animal from the local State or Federal livestock sanitary official having jurisdiction.

§ 9.17 **Brucellosis-reactor Goats.** Goats which have reacted to a test for brucellosis shall not be slaughtered in an official establishment.

§ 9.18 **Vesicular Diseases.** (*a*) Immediate notification shall be given to the local State and Federal livestock sanitary officials having jurisdiction when an animal is found to be affected with a vesicular disease.

b) No animal under quarantine by State or Federal livestock sanitary officials on account of a vesicular disease will be given ante-mortem inspection.

c) If no quarantine is invoked, or if a quarantine is invoked and later lifted, ante-mortem inspection shall be as follows:

1) Any animal affected with vesicular exanthema or vesicular stomatitis in the acute stages, as evidenced by acute and active lesions or an elevated temperature, shall be marked "U. S. condemned" and disposed of in accordance with § 9.16.

2) Any animal affected with vesicular exanthema, or vesicular stomatitis, but which has recovered to the extent that the lesions are in process of healing, the temperature is within normal range, and the animal shows a return to normal appetite and activity, shall be marked "U. S. suspect" and disposed of in accordance with § 9.2, except that if desired, such animal may be set apart and held under division or other responsible official supervision for treatment. If the animal is set aside for treatment, the "U. S. suspect" tag will be removed by a division employee, either when the animal is released for treatment to a responsible official, or following treatment while under custody of a division employee if the animal is found to be free from disease. Such animal, found to be free from disease, may be released for slaughter or for purposes other than slaughter: *Provided*, That in the latter instance, the official establishment or the owner of the animal shall first obtain permission from the local State or Federal livestock sanitary official having jurisdiction of the movement of such animal.

PART 10—POST-MORTEM INSPECTION

§ 10.1 **Extent and Time of Post-mortem Inspection.** A careful post-mortem examination and inspection shall be made of the carcasses and parts thereof of all cattle, sheep, swine, and goats slaughtered at official establishments. Such inspection and examination shall be made at the time of slaughter, except in cases of emergencies provided for in § 11.29 of this subchapter.

§ 10.2 **Organs and Parts to be Held Pending Final Inspection of Carcasses.** The head, tongue, tail, thymus gland, and all viscera, and all parts and blood to be used in the preparation of meat food products or medical products, shall be held in such manner as to preserve their identity until after post-mortem examination has been completed, in order that they may be identified in case the carcass is condemned, passed for cooking or held for refrigeration.

§ 10.3 **Carcasses and Parts in Certain Instances to be Retained.** Each carcass, including all detached parts and organs thereof, in which any lesion or other condition is found that might render the meat or any part or organ unfit for food purposes, and which for that reason would require a subsequent inspection, shall be retained by the division employee at the time of inspection. The identity of every such retained carcass, detached part, and organ thereof shall be maintained until the final inspection has been completed. Retained carcasses shall not be washed or trimmed unless authorized by the inspector.

§ 10.4 **Identification of Carcasses and Parts; Tagging.** Such devices and methods as may be approved by the chief of division may be used for the temporary identification of retained carcasses, parts, or organs. In all cases the identification shall be further established by affixing "U. S. retained" tags as soon as practicable and before final inspection. These tags shall not be removed except by a division employee.

§ **10.5 Condemned Carcasses and Parts to be So Marked; Tanking; Separation.** Each carcass or part which is found on final inspection to be unsound, unhealthful, unwholesome, or otherwise unfit for human food shall be conspicuously marked on the surface tissues thereof by a division employee at the time of inspection "U. S. inspected and condemned." Condemned detached parts and organs of such character that they cannot be so marked shall be placed immediately in trucks or receptacles which shall be kept plainly marked "U. S. inspected and condemned," in letters not less than 2 inches high. All condemned carcasses, parts, and organs shall remain in the custody of a division employee and shall be tanked as required in the regulations in this subchapter at or before the close of the day on which they are condemned.

§ **10.6 Carcasses and Parts Passed for Cooking; Marking.** Carcasses and parts passed for cooking shall be marked conspicuously on the surface tissues thereof by a division employee at the time of inspection, "U. S. passed for cooking." All such carcasses and parts shall be cooked in accordance with Part 15 of this subchapter, and until so cooked shall remain in the custody of a division employee.

§ **10.7 Disposal of Parts Showing Localized Lesions; Removal of Spermatic Cords and Pizzles.** (*a*) In all cases where carcasses showing localized lesions are passed for food or for cooking, the diseased parts shall be removed before the "U. S. retained" tag is taken from the carcass, and such parts shall be condemned.

b) Spermatic cords shall be removed from hog carcasses, and pizzles from all carcasses.

§ **10.8 Passing and Marking of Carcasses and Parts.** Carcasses and parts found to be sound, healthful, wholesome, and fit for human food shall be passed and marked as elsewhere provided in this subchapter.

§ **10.9 Anthrax; Carcasses not to be Eviscerated; Carcasses Affected to be Tanked Immediately; Hides, Hoofs, Horns, Hair, Viscera and Contents, and Fat to be Tanked; Handling of Blood and Scalding Vat Water; General Clean-up and Disinfection.** (*a*) Carcasses found before evisceration to be affected with anthrax shall not be eviscerated but shall be retained, condemned, and immediately tanked or otherwise disposed of as provided in Part 14 of this subchapter.

b) All carcasses and all parts, including hides, hoofs, horns, hair, viscera and contents, blood and fat, found to be affected with anthrax shall be condemned and immediately disposed of as provided in Part 14 of this subchapter, except that the blood may be handled through the usual blood cooking and drying equipment.

c) The part of any carcass contaminated with anthrax-infected material through contact with soiled instruments or otherwise shall be immediately condemned and disposed of as provided in Part 14 of this subchapter.

d) The scalding vat water through which hog carcasses affected with anthrax have passed shall be immediately drained into the sewer and all parts of the scalding vat shall be cleaned and disinfected as provided in paragraph (*e*) of this section.

e) (1) That portion of the slaughtering department (bleeding area, scalding vat, gambrelling bench, floors, walls, posts, platforms, saws, cleavers, knives, hooks, and the like), as well as employees' boots and aprons contaminated through contact with anthrax-infected material, shall, except as provided in subparagraph (2) of this paragraph, be cleaned immediately and disinfected with one of the following disinfectants or other disinfectant approved specifically for this purpose by the chief of division:

i) A 5 per cent solution of sodium hydroxide or commercial lye containing at least 94 per cent of sodium hydroxide. The solution should be prepared freshly immediately before use by dissolving $2\frac{1}{2}$ pounds of sodium hydroxide or lye in $5\frac{1}{2}$ gallons of hot water and should be applied as near scalding hot as possible to be most effective. (Owing to the extreme caustic nature of sodium hydroxide solution, precautionary measures such as the wearing of rubber gloves and boots to protect the hands and feet, and goggles to protect the eyes, should be taken by those engaged on the disinfection job. It is also advisable to have an acid solution, such as vinegar, in readiness in case any of the sodium hydroxide solution should come in contact with any part of the body.)

ii) A solution of sodium hypochlorite containing approximately one-half of 1

per cent (5,000 parts per million) of available chlorine. The solution should be freshly prepared.

iii) When a disinfectant solution has been applied to equipment which will afterwards contact meat, the equipment shall be rinsed with clean water before again being used.

2) In case anthrax infection is found in the hog slaughtering department, an immediate preliminary disinfection shall extend from the head-dropper's station to the point where the disease is detected and the affected carcasses shall be cut down and removed from the room. Upon completion of the slaughtering of the lot of hogs of which the anthrax-infected animals were a part, slaughtering operations shall cease, and a thorough clean-up and disinfection shall be made, as provided in subparagraph (1) of this paragraph. If the slaughter of the lot has not been completed by the close of the day, the clean-up and disinfection shall not be deferred beyond the close of the day on which anthrax was detected.

3) The first and indispensable precautionary step for persons who have handled anthrax material is thorough cleansing of the hands and arms with liquid soap and running hot water. It is important that this step be taken immediately after exposure, before vegetative anthrax organisms have had time to form spores. In the cleansing, a brush or other appropriate appliance should be used to insure the removal of all contaminating material from under and about the fingernails. This process of cleansing is most effective when performed in repeated cycles of lathering and rinsing, rather than in spending the same amount of time in scrubbing with a single lathering. After the hands have been cleansed thoroughly and rinsed free of soap, they may, if desired, be immersed for about one minute in a 1:1,000 solution of bichloride of mercury, followed by thorough rinsing in clean running water. Supplies of bichloride of mercury for the purpose must be held in the custody of the inspector in charge. As a precautionary measure, all persons exposed to anthrax infection should report promptly any suspicious condition (sore or carbuncle) or symptom to a physician, in order that anti-anthrax serum or other treatment may be administered as indicated.

§ **10.10 Carcasses with Skin or Hide on; Cleaning Before Evisceration; Removal of Larvae of Oestrus Bovis.** When a carcass is to be dressed with the skin or hide left on, the skin or hide shall be thoroughly washed and cleaned before any incision is made for the purpose of removing any part thereof or evisceration, except that where calves are slaughtered by the kosher method, the heads shall be removed from the carcasses before washing of the carcasses. The skin shall be removed at the time of post-mortem inspection from any calf carcass infested with the larvæ of the "ox-warble" fly (*Hypoderma lineata* and *Hypoderma bovis*).

§ **10.11 Cleaning of Hog Carcasses Before Incising.** All hair, scurf, and dirt, including all hoofs and claws, shall be removed from hog carcasses, and the carcasses thoroughly washed and cleaned before any incision is made for inspection or evisceration.

§ **10.12 Sternum to be Split; Abdominal and Thoracic Viscera to be Removed.** The sternum of each carcass shall be split and the abdominal and thoracic viscera removed at the time of slaughter in order to allow proper inspection.

§ **10.13 Carcasses or Parts Thereof not to be Inflated; Transferring Caul or Other Fat.** Carcasses or parts of carcasses shall not be inflated with air. Transferring the caul or other fat from a fat to a lean carcass is prohibited.

§ **10.14 Handling of Bruised Parts.** When only a portion of a carcass is to be condemned on account of slight bruises, either the bruised portion shall be removed immediately and disposed of in accordance with Part 14 of this subchapter, or the carcass shall be promptly placed in a retaining room and kept until chilled and the bruised portion then removed and disposed of as provided above.

§ **10.15 Skins from Diseased Swine; Removal from Establishments; Disinfection; Separate Compartments.** The skins from swine condemned for tuberculosis or any disease communicable to man or other animal may be removed from the establishment, except as provided in § 10.9, for tanning or other industrial use; but they shall be removed for these uses only after they have been disinfected, as follows: Each skin shall be immersed for not less than 5 minutes in a 5 per cent solution of liquor cresolis compositus, or a 5 per cent solution of carbolic acid, or

shall be otherwise treated as prescribed by the chief of division. The process of skinning and disinfecting shall be conducted in a specially prepared place approved by the inspector in charge, and under the supervision of a division employee.

§ **10.16 Hyperimmune Swine Bled Before Entering Official Establishments.** Carcasses of hyperimmune swine which have been given the final bleeding at a serum plant under supervision of the Bureau of Animal Industry of the Department may be transferred to an official establishment for dressing and post-mortem inspection in accordance with the provisions of this part when authorized by the chief of the division. The transfer of such carcasses to the official establishment shall be made as promptly as possible and their delivery to the scalding vat shall be accomplished within 1 hour from the time bleeding is completed. The identity of the carcasses of hyperimmune swine shall be maintained in such manner as to positively identify them and to indicate the time of final bleeding. Procedures for maintaining this identity shall be such as will serve the purposes of the Virus-Serum Control Division of the Bureau of Animal Industry and the Meat Inspection Division, and shall be formulated by the inspectors in charge of the divisions involved. Each day that hyperimmune swine are presented for post-mortem inspection an ante-mortem report MI 402–1 covering such swine shall be rendered by the inspector at the serum plant and furnished the inspector in charge of meat inspection.

§ **10.17 Inspection of Cattle, Calf, and Sheep Lungs; Hog Lungs not to be Saved as Edible.** (*a*) All cattle, calf, and sheep lungs intended for food purposes shall be inspected to determine whether foreign matter is present in the air passages. The main bronchi and branches shall be slit by employees of the establishment as required by the inspector, and, if ingesta or other objectionable foreign matter has entered these passages, the lungs shall be condemned.

b) Hog lungs shall not be saved as edible product.

§ **10.18 Inspection of Mammary Glands.** (*a*) Lactating mammary glands and diseased mammary glands of cattle, sheep, swine, and goats shall be removed without opening the milk ducts or sinuses. If pus or other objectionable material is permitted to come in contact with the carcass, the parts of the carcass thus contaminated shall be removed and condemned.

b) Cow udders may be saved for food purposes, provided suitable facilities for handling and inspecting them are provided.

c) The inspection of udders from cows which have been kept for breeding purposes only shall consist of examination by palpation and, when necessary, by incision. The inspection of udders from cows which have been used for dairy purposes shall include slicing in sections about 2 inches in thickness. This slicing shall be done by establishment employees. The udders in the sliced condition shall be given a careful examination by division employees. The inspector will designate the udders which are to be sliced. When there is any doubt as to whether the udder is from a cow which has been used for breeding purposes only, then the udder shall be sliced and inspected as provided for udders from cows used for dairy purposes. Each udder shall be properly identified with its respective carcass and kept separate and apart from other udders until its disposal has been determined, when it may be further handled as the conditions warrant.

d) The udders from cows officially designated as "Bang's disease reactors" or as "mastitis elimination cows" shall not be utilized for edible purposes.

e) Lactating mammary glands of swine intended for edible purposes shall be handled and inspected in the same manner as provided in paragraph (*c*) of this section for the udders of cows used for dairy purposes, except that the sliced sections shall be about 1 inch in thickness. Glands that are passed may be distributed as such but their use in meat food products is limited to the preparation of rendered pork fat.

PART 11—DISPOSAL OF DISEASED CARCASSES AND PARTS

§ **11.1 Disposal of Diseased Carcasses and Parts; General.** (*a*) The carcasses or parts of carcasses of all animals slaughtered at an official establishment and found at the time of slaughter or at any subsequent inspection to be affected with

any of the diseases or conditions named in this part shall be disposed of according to the section pertaining to the disease or condition. Owing to the fact that it is impracticable to formulate rules covering every case and to designate at just what stage a process becomes loathsome or a disease noxious, the decision as to the disposal of all carcasses, parts, or organs not specifically covered in this subchapter shall be left to the inspector in charge.

b) In cases of doubt as to a condition, a disease, or the cause of a condition, or to confirm a diagnosis, representative specimens of the affected tissues properly prepared and packaged should be sent to one of the Bureau of Animal Industry pathological laboratories for examination.

§ **11.2 Tuberculosis; Principles for Guidance in Passing on Carcasses Affected.** The following principles are declared for guidance in passing on carcasses affected with tuberculosis:

a) No meat should be passed for food if it contains tubercle bacilli, or if there is a reasonable possibility that it may contain tubercle bacilli, or if it is impregnated with toxic substance of tuberculosis or associated septic infections.

b) Meat should not be destroyed if the lesions are localized and not numerous, if there is no evidence of distribution of tubercle bacilli through the blood or by other means to the muscles or to parts that may be eaten with the muscles, and if the animal is well nourished and in good condition, since in this case there is no proof, or even reason to suspect, that the flesh is unwholesome.

c) Evidences of generalized tuberculosis are to be sought in such distribution and number of tuberculous lesions as can be explained only upon the supposition of the entrance of tubercle bacilli in considerable number into the systemic circulation. Significant of such generalization is the presence of numerous uniformly distributed tubercles throughout both lungs, also tubercles in the spleen, kidneys, bones, joints, and sexual glands and in the lymph glands connected with these organs and parts, or in the splenic, renal, prescapular, popliteal, and inguinal glands, when several of these organs and parts are coincidentally affected.

d) Localized tuberculosis is tuberculosis limited to a single or several parts or organs of the body without evidence of recent invasion of numerous bacilli into the systemic circulation.

§ **11.3 Disposition when Affected with Tuberculosis.** The carcasses of animals affected with tuberculosis shall be disposed of as follows:

a) The entire carcass shall be condemned if any of the following conditions occur:

1) When it was observed before the animal was killed that it was suffering with fever.

2) When there is a tuberculous or other cachexia.

3) When the lesions of tuberculosis are generalized, as shown by their presence not only at the usual seats of primary infection but also in parts of the carcass or in the organs that may be reached by the bacilli of tuberculosis only when they are carried in the systemic circulation. Tuberculous lesions in any two of the following-mentioned organs are to be accepted as evidence of generalization when they occur in addition to local tuberculous lesions in the digestive or respiratory tracts, including the lymph glands connected therewith: spleen, kidney, uterus, udder, ovary, testicle, adrenal gland, and brain or spinal cord or their membranes. Numerous tubercles uniformly distributed throughout both lungs also afford evidence of generalization.

4) When the lesions of tuberculosis are found in the muscles or intermuscular tissue or bones or joints, or in the body lymph glands as a result of draining the muscles, bones, or joints.

5) When the lesions are extensive in one or both body cavities.

6) When the lesions are multiple, acute, and actively progressive. (Evidence of active progress consists of signs of acute inflammation about the lesions, or liquefaction necrosis, or the presence of young tubercles.)

b) An organ or a part of a carcass shall be condemned under any of the following conditions:

1) When it contains lesions of tuberculosis.

2) When the lesion is localized but immediately adjacent to the flesh as in the case of tuberculosis of the parietal pleura or peritoneum. In this case not only the

membrane or part affected but also the adjacent thoracic or abdominal wall is to be condemned.

3) When it has been contaminated by tuberculous material through contact with the floor or a soiled knife or otherwise.

4) Heads showing lesions of tuberculosis shall be condemned, except that when a head is from a carcass passed for food or for cooking and the lesions are slight, or calcified, or encapsulated, and are confined to lymph glands in which not more than two glands are involved, the head may be passed for cooking after the diseased tissues have been removed and condemned.

5) An organ shall be condemned when the corresponding lymph gland is tuberculous.

6) Intestines and mesenteries showing lesions of tuberculosis shall be condemned, except that when the lesions are slight and confined to the lymph glands and the carcass is passed without restriction, the intestines may be passed for use as casings and the fat passed for rendering after the corresponding lymph glands have been removed and condemned: *Provided*, That the fat and intestines have not been contaminated with tuberculous material.

c) Carcasses showing lesions of tuberculosis should be passed for food when the lesions are slight, localized, and calcified or encapsulated, or are limited to a single or several parts or organs of the body (except as noted in paragraph (*a*) of this section), and there is no evidence of recent invasion of tubercle bacilli into the systemic circulation. Under this paragraph carcasses showing such lesions as the following examples may be passed, after the parts containing the lesions are removed and condemned in accordance with paragraph (*b*) of this section:

1) In the cervical lymph glands and two groups of visceral lymph glands in a single body cavity, such as the cervical, bronchial, and mediastinal glands, or the cervical, hepatic, and mesenteric glands.

2) In the cervical lymph glands and one group of visceral lymph glands and one organ in a single body cavity, such as the cervical and bronchial glands and lungs, or the cervical and hepatic glands and the liver.

3) In two groups of visceral lymph glands and one organ in a single body cavity, such as the bronchial and mediastinal glands and the lungs, or the hepatic and mesenteric glands and the liver.

4) In two groups of visceral lymph glands in the thoracic cavity and one group in the abdominal cavity, or in one group of visceral lymph glands in the thoracic cavity and two groups in the abdominal cavity, such as the bronchial, mediastinal, and hepatic glands, or the bronchial, hepatic, and mesenteric glands.

5) In the cervical lymph glands and one group of visceral lymph glands in each body cavity, such as the cervical, bronchial, and hepatic glands.

6) In the cervical lymph glands and one group of visceral lymph glands in each body cavity, together with the liver when the latter contains but a few localized foci. In this class of carcasses, which will be chiefly those of hogs, the lesions of the liver are considered to be primary, as the disease is practically always of alimentary origin.

d) Carcasses which reveal lesions more severe or more numerous than those described for carcasses to be passed (paragraph [*c*] of this section), but not so severe nor so numerous as the lesions described for carcasses to be condemned (paragraph [*a*] of this section), may be rendered into lard, rendered pork fat, or tallow, or otherwise cooked in accordance with Part 15 of this subchapter, if the distribution of the lesions is such that all parts containing tuberculous lesions can be removed.

§ **11.4 Hog Cholera; Disposition of Hog Carcasses on Account of.** (*a*) The carcasses of all hogs affected with acute hog cholera shall be condemned.

b) Inconclusive but suspicious symptoms of hog cholera observed during the ante-mortem inspection shall be duly considered in connection with post-mortem findings and when the carcass of such a "suspect" shows lesions in the kidneys and the lymph glands which resemble lesions of hog cholera, they shall be regarded as those of hog cholera and the carcass shall be condemned.

c) Inasmuch as lesions resembling lesions of hog cholera occur in the kidneys and lymph glands of hogs not affected with hog cholera, carcasses of hogs in the

kidneys or lymph glands of which appear any lesions resembling lesions of hog cholera shall be carefully further inspected for corroborative lesions. If on such further inspection the carcass shows such lesions in the kidneys or in the lymph glands or in both, accompanied by characteristic lesions in some organ or tissue, then all lesions shall be regarded as those of hog cholera and the carcass shall be condemned.

§ **11.5 Carcasses of Swine Injected with Hog Cholera Virus.** (*a*) Carcasses of swine, other than hyperimmune swine, if presented for inspection after 28 days following injection with hog cholera virus shall be given post-mortem inspection in conformity with this part without reference to the injected virus.

b) Carcasses of hyperimmune swine if presented for inspection after 10 days following hyperimmunization shall be given post-mortem inspection in conformity with this part without reference to the injected virus.

§ **11.6 Swine Erysipelas.** Carcasses affected with swine erysipelas which is acute or generalized, or which show systemic change, shall be condemned.

§ **11.7 Diamond-skin Disease.** Carcasses of hogs affected with diamond-skin disease when localized and not associated with systemic change may be passed for food after removal and condemnation of the affected parts: *Provided,* Such carcasses are otherwise in good condition.

§ **11.8 Arthritis and Polyarthritis.** (*a*) Carcasses affected with arthritis or polyarthritis when localized and not associated with systemic change may be passed for food after removal and condemnation of all affected parts: *Provided,* The carcasses are otherwise in good condition. Affected joints with corresponding lymph glands shall be removed and condemned. In order to avoid contamination of the meat which is passed a joint capsule shall not be opened until after the affected joint is removed.

b) Carcasses affected with arthritis or polyarthritis characterized by the presence of periarticular abscesses which may or may not be connected with similar suppurative foci within the epiphyses of the bones shall be condemned in cases manifesting suppurative lesions in more than one joint. Otherwise, the condemnations shall be restricted to the affected parts if such carcasses are otherwise in good condition.

§ **11.9 Cattle Carcasses Affected with Anasarca or Generalized Edema.** (*a*) Carcasses of cattle found on post-mortem inspection to be affected with anasarca in advanced stages and characterized by an extensive or well-marked generalized edema shall be condemned.

b) Carcasses of cattle, including their detached parts and organs, found on post-mortem inspection to be affected with anasarca to a lesser extent than in paragraph (*a*) of this section may be passed for food after removal and condemnation of the affected tissues, provided the lesion is localized.

§ **11.10 Actinomycosis and Actinobacillosis; Disposition of Carcasses and Parts.** (*a*) The definition of generalization as outlined for tuberculosis in § 11.3 (*a*) shall apply for actinomycosis and actinobacillosis, and carcasses of animals so affected shall be condemned.

b) Carcasses of animals in a well-nourished condition showing uncomplicated localized lesions of actinomycosis or actinobacillosis may be passed after the infected organs or parts have been removed and condemned, except as provided in paragraphs (*c*) and (*d*) of this section.

c) Heads affected with actinomycosis or actinobacillosis, including the tongue, shall be condemned, except that when the disease of the jaw is slight, strictly localized, and without suppuration, fistulous tracts, or lymph gland involvement, the tongue, if free from disease, may be passed, or, when the disease is slight and confined to the lymph glands, the head, including the tongue, may be passed after the affected glands have been removed and condemned.

d) When the disease is slight and confined to the tongue, with or without involvement of the corresponding lymph glands, the head may be passed after removal and condemnation of the tongue and corresponding lymph glands.

§ **11.11 Anaplasmosis, Anthrax, Bacillary Hemoglobinuria in Cattle, Blackleg, Hemorrhagic Septicemia, Icterohematuria in Sheep, Malignant Epizootic Catarrh, Piroplasmosis, Pyemia, Septicemia, Unhealed Vaccine Lesions; Carcasses Affected with, to be Condemned.** Carcasses of animals affected with or showing lesions of any of the following-named diseases or conditions shall be condemned:

a) Anaplasmosis.
b) Anthrax.
c) Bacillary hemoglobinuria in cattle.
d) Blackleg.
e) Hemorrhagic septicemia.
f) Icterohematuria in sheep.
g) Malignant epizootic catarrh.
h) Piroplasmosis.
i) Pyemia.
j) Septicemia.
k) Unhealed vaccine lesions (vaccinia).

§ **11.12 Malignant Neoplasms; Disposition of Organs, Parts, or Carcasses.** Any individual organ or part of a carcass affected with a malignant neoplasm shall be condemned. In case the malignant neoplasm involves any internal organ to a marked extent, or affects the muscles, skeleton, or body lymph glands, even primarily, the carcass shall be condemned, except as provided in § 11.13. In case of metastasis to any other organ or part of a carcass, or if metastasis has not occurred but there are present secondary changes in the muscles (serous infiltration, flabbiness, or the like), the carcass shall be condemned. Carcasses of cattle affected with epithelioma of the eye shall be disposed of according to § 11.13.

§ **11.13 Epithelioma of the Eye of Cattle.** (*a*) Carcasses of animals affected with epithelioma of the eye, of the orbital region, and/or of the corresponding parotid lymph gland shall be condemned in their entirely if one of the following three conditions exists:

1) The affection has involved the osseous structures of the head with extensive infection, suppuration, and necrosis;

2) There is metastasis from the eye, the orbital region, and/or the corresponding parotid lymph gland to other lymph glands, internal organs, muscles, skeleton, or other structures, regardless of the extent of the primary tumor; or

3) The affection, regardless of extent, is associated with cachexia or evidence of absorption or secondary changes.

b) Carcasses of animals affected with epithelioma of the eye, of the orbital region, and/or of the corresponding parotid lymph gland to a lesser extent than in paragraph (*a*) of this section may be passed for food after removal and condemnation of the head, including the tongue: *Provided*, The carcass is otherwise in good condition.

§ **11.14 Carcasses Showing Disease such as Generalized Melanosis, etc., Affecting the System to be Condemned.** Carcasses of animals showing any disease such as generalized melanosis, leukemia, pseudo-leukemia, lymphoma, and the like, which affects the system of the animal, shall be condemned.

§ **11.15 Abrasions, Bruises, Tumors, Abscesses, Pus, etc.; Disposition of Carcasses and Parts.** All slight, well-limited abrasions on the tongue and inner surface of the lips and mouth, when without lymph-gland involvement, shall be carefully excised, leaving only sound, normal tissue, which may be passed. Any organ or part of a carcass which is badly bruised or which is affected by a tumor, an abscess, or a suppurating sore, shall be condemned; and when the lesions are of such character or extent as to affect the whole carcass, the whole carcass shall be condemned. Parts of carcasses which are contaminated by pus shall be condemned.

§ **11.16 Brucellosis.** Carcasses affected with localized lesions of brucellosis may be passed for food after the affected parts are removed and condemned.

§ **11.17 Carcasses so Infected that Consumption of the Meat may Cause Food Poisoning Shall be Condemned.** (*a*) All carcasses of animals so infected that consumption of the products thereof may give rise to food poisoning shall be condemned. This includes all carcasses showing signs of:

1) Acute inflammation of the lungs, pleura, pericardium, peritoneum, or meninges.

2) Septicemia or pyemia, whether puerperal, traumatic, or without any evident cause.

3) Gangrenous or severe hemorrhagic enteritis or gastritis.

4) Acute diffuse metritis or mammitis.

5) Phlebitis of the umbilical veins.

6) Septic or purulent traumatic pericarditis.

7) Any acute inflammation, abscess, or suppurating sore, if associated with acute nephritis, fatty and degenerated liver, swollen soft spleen, marked pulmonary hyperemia, general swelling of lymph glands, diffuse redness of the skin, cachexia, icteric discoloration of the carcass, or the like, either singly or in combination.

b) Implements contaminated by contact with carcasses affected with any of the diseased conditions mentioned in this section shall be thoroughly cleaned and disinfected as prescribed elsewhere in this subchapter. The equipment used in the dressing of such carcasses, such as viscera trucks, inspection tables, and the like, shall be disinfected with hot water having a minimum temperature of 180°F. Carcasses or parts of carcasses contaminated by contact with such diseased carcasses shall be condemned unless all contaminated tissues are removed within two hours.

§ 11.18 **Necrobacillosis, Pyemia, Septicemia; Disposition of Carcasses.** From the standpoint of meat inspection, necrobacillosis may be regarded as a local affection at the beginning, and carcasses in which the lesions are so localized may be passed for food if in a good state of nutrition, after removing and condemning those portions affected with necrotic lesions. On the other hand, when emanciation, cloudy swelling of the glandular organs, or enlargement and discoloration of the lymph glands are associated with the affection, it is evident that the disease has progressed beyond the condition of localization to a state of toxemia, and the entire carcass should therefore be condemned as both innutritious and noxious. Pyemia or septicemia may intervene as a complication of the local necrosis, and when present the carcass shall be condemned in accordance with § 11.17.

§ 11.19 **Caseous Lymphadenitis; Disposition of Carcasses and Parts.** (*a*) A thin carcass showing well-marked lesions in the viscera and the skeletal lymph glands or such a carcass showing extensive lesions in any part shall be condemned.

b) A thin carcass showing well-marked lesions in the viscera with only slight lesions elsewhere or showing well-marked lesions in the skeletal lymph glands with only slight lesions elsewhere may be passed for cooking.

c) A thin carcass showing only slight lesions in the skeletal lymph glands and in the viscera may be passed without restriction.

d) A well-nourished carcass showing well-marked lesions in the viscera and with only slight lesions elsewhere or showing well-marked lesions confined to the skeletal lymph glands with only slight lesions elsewhere may be passed without restriction.

e) A well-nourished carcass showing well-marked lesions in the viscera and the skeletal lymph glands may be passed for cooking; but where the lesions in a well-nourished carcass are both numerous and extensive, it shall be condemned.

f) All affected organs and glands of carcasses passed without restriction or passed for cooking shall be removed and condemned. The term "thin" as used in this section shall not be held applicable to a carcass which is anemic or emaciated.

§ 11.20 **Icterus; Disposition of Carcasses.** Carcasses showing any degree of icterus with a parenchymatous degeneration of organs, the result of infection or intoxication, and those which show an intense yellow or greenish-yellow discoloration without evidence of infection or intoxication, shall be condemned. Carcasses affected with icteric-like discoloration, the result of conditions other than those before stated in this section, but which lose such discoloration on chilling, shall be passed for food, while those which do not so lose such discoloration may be passed for food, while those which do not so lose such discoloration may be passed for cooking. No carcass retained under this section may be passed for food unless the final inspection thereof is completed under natural light. Carcasses passed for cooking under this section shall not be processed other than by rendering.

§ 11.21 **Urine or Sexual Odor; Disposition of Carcasses.** Carcasses which give off the odor of urine or a sexual odor shall be condemned. When the final inspection of such carcasses is deferred until they have been chilled, the disposal shall be determined by the heating test.

§ 11.22 **Mange or Scab; Disposition of Carcasses.** Carcasses of animals affected with mange or scab in advanced stages, showing cachexia or extensive inflammation of the flesh, shall be condemned. When the disease is slight, the carcass may be passed after removal of the affected portion.

§ **11.23 Hogs Affected with Urticaria, Tinea Tonsurans, Demodex Folliculorum, or Erythema; Disposition of Carcasses.** Carcasses of hogs affected with urticaria (nettle rash), tinea tonsurans, demodex folliculorum, or erythema may be passed after detaching and condemning the affected skin, if the carcass is otherwise fit for food.

§ **11.24 Tapeworm Cysts (Cysticercus bovis); Methods of Inspecting for; Carcasses and Parts of Cattle Infested with; Disposition of Carcasses and Parts; Conditions Under Which Refrigeration Permitted; Calves Excepted.** (*a*) *Head.* Prior to inspection the tongue shall be detached sufficiently from the head bones, by an employee of the establishment, to allow a proper inspection to be made of the internal muscles of mastication. These muscles shall be inspected after incising them in such manner as to split the muscles in a plane parallel with the lower jawbone. The masseter muscles also shall be incised, splitting the entire external layer between the outer and intermediate fasciæ.

b) *Heart.* The preparation and inspection of hearts shall conform to one of the following methods:

1) The surface of the heart shall be examined, and a longitudinal incision made extending from base to apex through the wall of the left ventricle and the interventricular septum, after which the cut surfaces and the inner surfaces of the ventricles shall be examined.

2) After the external surface of the heart has been inspected the organ shall be prepared for further inspection by an establishment employee severing its attachments and cutting through the interventricular septum and such other tissues as will permit him to evert the organ completely. The inspector shall then examine the interior surfaces and make not more than four deep, lengthwise incisions into the muscles of the septum and left ventricular wall, unless the presence of cysts is suspected, when more incisions shall be made. Under this method care shall be taken not to cut completely through the walls of hearts to be passed without restriction. If necessary to maintain the identity of hearts, the establishment shall provide consecutively numbered tags and appropriately mark the carcasses and hearts.

c) *Final Inspection of Retained Carcasses.* The external and internal muscles of mastication, the heart, and the muscular portion of the diaphragm including its pillars, should be carefully and thoroughly sliced to insure the finding of all cysts. Prior to the inspection of the diaphragm its peritoneum shall be removed. The tongue shall be carefully inspected by palpation, and if the presence of cysts in the muscles of this organ is suspected, the tongue shall be thoroughly sliced and all parts closely examined for cysts. In addition to the foregoing, the muscles of the œsophagus, the exposed muscles, and cut muscular surfaces of the split carcass shall be examined. Incisions may be made to expose additional surfaces for examination, but unnecessary mutilation of carcasses which may be passed shall be avoided.

d) Carcasses of cattle (including the viscera) infested with tapeworm cysts known as *Cysticercus bovis* shall be condemned if the infestation is excessive or if the meat is watery or discolored. Carcasses shall be considered excessively infested if incisions in various parts of the musculature expose on most of the cut surfaces two or more cysts within an area the size of the palm of the hand.

e) A carcass in which infestation with *Cysticercus bovis* is limited to one dead and degenerated cyst may be passed for food after removal and condemnation of the cyst.

f) Carcasses of cattle showing a slight or moderate infestation other than that indicated in paragraph (*e*) of this section but not so extensive as indicated in paragraph (*d*) of this section, as determined by a careful examination of the heart, muscles of mastication, diaphragm and its pillars, tongue, and of portions of the carcass rendered visible by the process of dressing, may be passed for food after removal and condemnation of the cysts, with the surrounding tissues: *Provided*, That the carcasses and parts, appropriately identified by retained tags, are held in cold storage at a temperature not higher than 15°F. continuously for a period of not less than 10 days: *And provided further*, That the boned meat from such carcasses when in boxes, tierces, or like containers, appropriately identified by retained tags, is held at a temperature of not higher than 15°F. continuously for a period of not

less than 20 days. As an alternative to retention in cold storage as herein provided, such carcasses and parts may be heated throughout to a temperature of at least 140°F.

g) The edible viscera (except the lungs, fat, muscles of the œsophagus, and heart, which shall take the same disposition as the carcasses), of carcasses passed for food or for refrigeration under the provisions of paragraph (*f*) of this section may be passed for food without refrigerating or heating: *Provided*, They are found to be free from infestation upon final inspection. The intestines, weasands, and bladders from beef carcasses affected with *Cysticercus bovis*, which have been passed for food or for refrigeration, may be used for casings after they have been subjected to the usual methods of preparation and may be passed for such purpose upon completion of the final inspection.

h) The inspection for *Cysticercus bovis* may be omitted in the case of calves under 6 weeks old. The routine inspection of calves over 6 weeks old for *Cysticercus bovis* may be limited to a careful examination of the surface of the heart and such other surfaces as are rendered visible by the process of dressing.

§ 11.25 Hogs Affected with Tapeworm Cysts (Cysticercus cellulosæ); Disposition. Carcasses of hogs affected with tapeworm cysts (*Cysticercus cellulosæ*) may be passed for cooking, but if the infestation is excessive the carcass shall be condemned.

§ 11.26 Disposal of Carcasses, Organs, and Parts Showing Evidence of Infestation with Parasites not Transmissible to Man; Sheep Carcasses Affected with Tapeworm Cysts; Carcasses Infested with Gid Bladder Worms; Organs and Parts Infested with Hydatid Cysts; Livers Infested with Flukes. (*a*) In the disposal of carcasses, edible organs, and parts of carcasses showing evidence of infestation with parasites not transmissible to man, the following general rules shall govern: If the lesions are localized in such manner and are of such character that the parasites and the lesions caused by them may be radically removed, the nonaffected portion of the carcass, organ, or part of the carcass may be passed for food after the removal and condemnation of the affected portions. If an organ or a part of a carcass shows numerous lesions caused by parasites, or if the character of the infestation is such that complete extirpation of the parasites and lesions is difficult and uncertainly accomplished, or if the parasitic infestation or invasion renders the organ or part in any way unfit for food, the affected organ or part shall be condemned. If parasites are found to be distributed in a carcass in such a manner or to be of such a character that their removal and the removal of the lesions caused by them is impracticable, no part of the carcass shall be passed for food. If the infestation is excessive the carcass shall be condemned. If the infestation is moderate the carcass may be passed for cooking, but in case such carcass is not cooked as required by Part 15 of this subchapter it shall be condemned.

b) In the case of sheep carcasses affected with tapeworm cysts located in the muscles (*Cysticercus ovis*, so-called sheep measles, not transmissible to man), the carcass may be passed after the removal and condemnation of the affected portions: *Provided, however*, That if upon the final inspection of sheep carcasses retained on account of measles the total number of cysts found embedded in muscle or in immediate relation with muscular tissue, including the heart, exceeds five, this shall be taken to indicate that the cysts are so generally distributed and so numerous that their removal would be impracticable, and the entire carcass shall be condemned or passed for cooking, according to the degree of infestation. If not to exceed five cysts are found upon final inspection, the carcass may be passed after the removal and condemnation of the affected portions.

c) Carcasses of animals found infested with gid bladder worms (*Cœnurus cerebralis, Multiceps multiceps*) may be passed after condemnation of the affected organ (brain or spinal cord).

d) Organs or parts of carcasses infested with hydatid cysts (echinococcus) shall be condemned.

e) Livers infested with flukes or fringed tapeworms shall be condemned.

§ 11.27 Emaciated or Anemic Carcasses and Those Showing Slimy Fat Degeneration or Serous Muscular Infiltration. Carcasses of animals too emaciated or anemic to produce wholesome meat, and carcasses which show a slimy degenera-

tion of the fat or a serous infiltration of the muscles, shall be condemned. Mere leanness should not be classed as emaciation.

§ 11.28 **Carcasses Showing Advanced Pregnancy, etc.; Disposition.** Carcasses of animals in advanced stages of pregnancy (showing signs of parturition), also carcasses of animals which have within 10 days given birth to young and in which there is no evidence of septic infection, may be passed for cooking and handled as provided in Part 15 of this subchapter; otherwise, they shall be condemned.

§ 11.29 **Slaughter of Injured Animals at Unusual Hours.** When it is necessary for humane reasons to slaughter an injured animal at night or on Sunday or a holiday when the inspector cannot be obtained, the carcass and all parts shall be kept for inspection, with the head and all viscera except the stomach, bladder, and intestines held by the natural attachments. If all parts are not so kept for inspection, the carcass shall be condemned. If on inspection of a carcass slaughtered in the absence of an inspector any lesion or condition is found indicating that the animal was sick or diseased, or if there is lacking evidence of the condition which rendered emergency slaughter necessary, the carcass shall be condemned.

§ 11.30 **Carcasses of Young Calves, Pigs, Kids, and Lambs; when Condemned.** Carcasses of young calves, pigs, kids, and lambs are unwholesome and shall be condemned if (*a*) the meat has the appearance of being water-soaked, is loose, flabby, tears easily, and can be perforated with the fingers; or (*b*) its color is grayish red; or (*c*) good muscular development as a whole is lacking, especially noticeable on the upper shank of the leg, where small amounts of serous infiltrates or small edematous patches are sometimes present between the muscles; or (*d*) the tissue which later develops as the fat capsule of the kidneys is edematous, dirty yellow, or grayish red, tough, and intermixed with islands of fat.

§ 11.31 **Unborn and Stillborn Animals.** All unborn and stillborn animals shall be condemned and no hide or skin thereof shall be removed from the carcass within a room in which edible products are handled.

§ 11.32 **Condemnation of Animals Suffocated and Hogs Scalded Alive.** All animals which have been suffocated in any way and hogs which have entered the scalding vat alive shall be condemned.

§ 11.33 **Livers Affected with Carotenosis; Livers Designated as "Telangiectatic," "Sawdust," or "Spotted"; Disposal.** (*a*) Livers affected with carotenosis shall be condemned.

b) Cattle livers and calf livers showing the conditions sometimes designated as "telangiectatic," "sawdust," or "spotted" shall be disposed of as follows:

1) When any or all of the conditions are extensive and involve one-half or more of an organ, the whole organ shall be condemned.

2) When any or all of the conditions are slight in an organ, the whole organ shall be passed without restriction.

3) When any or all of the conditions involve the whole organ, and are less severe than extensive, but more severe than slight, the whole organ shall be cooked.

4) When any or all of the conditions are less severe than extensive, but more severe than slight in a portion of an organ, while in the remainder of the organ the conditions are slight, the remainder shall be passed without restriction and the other portion shall be cooked.

5) When any or all of the conditions are extensive and involve less than one-half of the organ, while in the remainder of the organ the conditions are slight, the remainder shall be passed without restriction and the other portion shall be condemned.

6) When any or all of the conditions are extensive and involve less than one-half of the organ, while in any or all of the remainder of the organ the conditions are more severe than slight yet less severe than extensive, all of the remainder shall be cooked and the extensively involved portion shall be condemned.

7) The division of an organ into but two parts as herein contemplated for disposition, shall be accomplished by one cut through the organ. This, of course, does not prohibit incisions which are necessary for inspection.

c) Livers and parts of livers which are required to be cooked shall be held and cooked in the establishment where produced. They shall be cooked sufficiently

to impart a cooked appearance throughout the liver. After cooking, the liver may be released for any purpose.

§ 11.34 **Vesicular Exanthema and Vesicular Stomatitis.** (*a*) Any carcass affected with vesicular exanthema or vesicular stomatitis shall be condemned if the condition is acute or if the extent of the condition is such that it affects the entire carcass or there is evidence of absorption or secondary change.

b) Any carcass affected with vesicular exanthema or vesicular stomatitis to a lesser extent than in paragraph (*a*) of this section may be passed after removal and condemnation of affected parts, if the carcass is otherwise in good condition.

PART 12—CARCASSES OF ANIMALS SLAUGHTERED WITHOUT ANTE-MORTEM INSPECTION

§ 12.1 **Carcasses of Animals Slaughtered without Ante-mortem Inspection.** No carcass of an animal slaughtered in the United States which has not had ante-mortem inspection by a division employee shall be brought into an official establishment, except that carcasses of cattle, sheep, swine, and goats, slaughtered by a farmer on the farm, to which the head and all viscera other than the stomach, bladder, and intestines are held by the natural attachments, may be received for inspection at official establishments where there is a veterinary meat inspector, upon the conditions prescribed in this section. After receipt in an official establishment, every such carcass shall be given a thorough post-mortem inspection. If, on inspection of any such carcass, there is found any lesion or condition indicating that the animal was sick or diseased, the carcass shall be condemned and disposed of in accordance with Part 14 of this subchapter. If, on inspection the carcass is found to be free from disease and otherwise found healthful, wholesome, and fit for human food, it shall be marked with the inspection legend.

PART 13—TANK ROOMS AND TANKS

§ 13.1 **Tanks, Rooms, and Equipment used for Inedible Products to be Separate and Apart from Those used for Edible Products.** All tanks and equipment used for rendering, preparing, or storing inedible products shall be in rooms or compartments separate from those used for rendering, preparing, or storing edible products. There shall be no connection between rooms or compartments containing inedible products and those containing edible products, except that there may be one connecting doorway between the slaughtering or viscera separating department and the tank charging room of the inedible products rendering department. Pipes and chutes installed in accordance with the requirements of the chief of division may be used to convey inedible and condemned material from edible product departments to inedible product departments.

§ 13.2 **Suppression of Odors in Preparing Inedible Product.** Tanks, fertilizer driers, and other equipment used in the preparation of inedible product shall be properly equipped with condensers and other appliances which will acceptably suppress odors incident to such preparation.

§ 13.3 **Carcasses of Animals Condemned on Ante-mortem Inspection Not to Pass Through Compartments for Edible Products.** In conveying to the inedible product tank carcasses of animals which have been condemned on ante-mortem inspection, they shall not be taken through rooms or compartments in which product is prepared, handled, or stored.

§ 13.4 **Dead-animal Carcasses.** (*a*) With the exception of dead animals which have died en route and are received with animals for slaughter at an establishment, no dead animal may be brought on the premises of an establishment unless advance permission therefor is obtained from the chief of division.

b) Under no circumstances shall the carcass of any animal which has died otherwise than by slaughter be brought into any room or compartment in which any product is prepared, handled, or stored.

§ 13.5 **Inedible Fats from Outside of Establishments.** Inedible fats from outside the premises of an official establishment shall not be received except into the tank room provided for inedible products, and then only when their receipt into the tank room produces no insanitary condition on the premises, nor shall such fats be received in such volume as interferes with prompt disposal of inedible or condemned material produced at the establishment. When received they shall not enter any room or compartment used for edible products.

PART 14—TANKING AND DENATURING CONDEMNED CARCASSES AND PARTS

§ 14.1 **Condemned Carcasses and Product; Disposing of, by Tanking; Sealing of Tanks; Denaturing of Product.** (*a*) Condemned carcasses and products at official establishments having facilities for tanking shall be disposed of by tanking as follows: The lower opening of the tank shall first be sealed securely by a division employee, except when permanently connected with a blow line, then the condemned carcasses and products shall be placed in the tank in his presence, after which the upper opening shall also be sealed securely by such employee, who shall then see that the contents of the tank are subjected to sufficient heating for sufficient time to destroy effectually the contents for food purposes.

b) The seals of tanks shall be broken only by a division employee after the contents of the tanks have been treated as provided in paragraph (*a*) of this section. The rendered fat derived from condemned material shall be held until a division employee shall have had an opportunity to determine whether it conforms with the requirements of this section. Samples shall be taken by division employees as often as is necessary to determine whether the rendered fat is effectually denatured.

§ 14.2 **Inedible Rendered Fats.** Rendered animal fat derived from inedible or condemned materials and possessing the physical characteristics of color, odor, and taste of an edible product shall be denatured to effectually distinguish it from an edible product either with low grade offal during the rendering or by adding to, and mixing thoroughly with, such fat denaturing oil, number 2 fuel oil, or brucine dissolved in a mixture of alcohol and pine oil or oil of rosemary.

§ 14.4 **Disposition of Condemned Meat or Product at Official Establishments Having No Tanking Facilities.** (*a*) Any carcass or product condemned at an official establishment which has no facilities for tanking shall be denatured with crude carbolic acid or other prescribed agent, or be destroyed by incineration, under the supervision of a division employee. When such carcass or product is not incinerated it shall be slashed freely with a knife, before the denaturing agent is applied.

b) Carcasses and products condemned on account of anthrax, and the materials identified in § 10.9 of this subchapter which are derived therefrom at establishments which are not equipped with tanking facilities shall be disposed of by (1) complete incineration, or (2) by thorough denaturing with a prescribed denaturant, and then disposed of in accordance with the requirements of the particular State or municipal authorities, who shall be notified immediately by the inspector in charge.

§ 14.5 **Specimens for Educational, Research, and Other Purposes; Permits for, Required.** (*a*) Specimens of diseased, condemned, and inedible materials, including pig or lamb embryos and specimens of animal parasites, may be released for educational purposes by the inspector in charge: *Provided*, That the party desiring such specimens makes a written application for same, stating the use to be made of them; and *Provided further*, That the applicant arranges with and receives permission from the official establishment to obtain the specimens. If the application is satisfactory to the inspector in charge, he shall issue a permit authorizing the removal of the specimens. Such permits shall be numbered and issued for not beyond the then current calendar year.

b) Specimens of diseased, condemned, and inedible materials, including pig or lamb embryos and specimens of animal parasites, may be released for research and other purpose swhen authorized by the chief of division: *Provided*, That the appli-

cant arranges with and receives permission from the official establishment to obtain the specimens.

(*c*) The collection and handling of the specimens referred to in paragraphs (*a*) and (*b*) of this section shall be at such time and place and in such a manner as not to interfere with the inspection or to cause any objectionable condition.

§ 14.6 Livers Condemned Because of Parasitic Infestation and for Other Causes; Conditions Under Which May be Disposed of as Fish Feed. (*a*) Livers condemned on account of fluke infestation may be forwarded as fish feed: *Provided*, The livers are first freely slashed and denatured by dipping in a hot solution containing one part of FD&C Green #3 or Methyl Violet in 5,000 parts of water, followed by washing in fresh water until the washings are no longer colored, or in lieu of the dye solution, dry, finely powdered charcoal may be applied, and then frozen at a temperature not higher than 10°F. for not less than 48 hours: or *Provided*, The livers are thoroughly cooked and then slashed and denatured as indicated above. It is essential that the livers be sufficiently denatured through discoloration by the dye or charcoal to preclude their use as human food. Freezing may be accomplished in the regular freezer in a properly separated compartment or receptacle held under division lock.

(*b*) Livers condemned on account of hydatids or fringed tapeworms may not be forwarded as fish feed unless thoroughly cooked, slashed, and denatured as indicated in paragraph (*a*) of this section.

(*c*) Livers condemned on account of parasites other than flukes, hydatids, or fringed tapeworms may be forwarded as fish feed without refrigeration or cooking after slashing and denaturing as indicated in paragraph (*a*) of this section.

(*d*) Livers condemned for telangiectasis, angioma, "sawdust" condition, cirrhosis, or other nonmalignant change, benign abscesses, or contamination, when these conditions are not associated with infectious diseases in the carcasses, may be forwarded as fish feed without refrigeration or cooking: *Provided*, All tissue affected with abscesses is removed and destroyed within the establishment: *And provided further*, That all livers are slashed and denatured as indicated in paragraph (*a*) of this section.

(*e*) Livers specified in the foregoing paragraphs shall be placed in containers plainly marked "fish feed—inedible," and when shipped in interstate commerce shall be certified as required by § 25.14 of this subchapter.

PART 15 RENDERING CARCASSES AND PARTS INTO LARD, RENDERED PORK FAT, AND TALLOW, AND OTHER COOKING

§ 15.1 Carcasses and Parts Passed for Cooking, Rendering into Lard, Rendered Pork Fat, or Tallow. Carcasses and parts passed for cooking may be rendered into lard or rendered pork fat (in accordance with subparagraphs (18) and (20), respectively, of § 17.8 (*c*) of this subchapter or rendered into tallow: *Provided*, Such rendering is done in the following manner:

(1) When closed rendering equipment is used, the lower opening, except when permanently connected with a blow line, shall first be sealed securely by a division employee, then the carcasses or parts shall be placed in such equipment in his presence, after which the upper opening will be securely sealed by such employee. When the product passed for cooking in the tank does not consist of a carcass or whole primal part, the requirements for sealing shall be at the discretion of the inspector in charge. Such carcasses and parts shall be cooked for a time sufficient to render them effectually into lard, rendered pork fat, or tallow: *Provided*, All parts of the product are heated to a temperature not lower than 170°F. for a period of not less than 30 minutes.

(2) Establishments not equipped with closed rendering equipment for rendering carcasses and parts passed for cooking into lard, rendered pork fat, and tallow may render such carcasses or parts in open kettles under the direct supervision of a division employee. Such rendering shall be done during regular hours of work and in compliance with the requirements as to temperature and time specified in subparagraph (1) of this paragraph.

§ **15.2 Carcasses and Parts Passed for Cooking not Rendered into Lard, Rendered Pork Fat, or Tallow; Utilization of, for Food Purposes after Cooking.** (*a*) Carcasses and parts passed for cooking, except as specified in § 11.20 of this subchapter, may be used for the preparation of such products as canned meat, sausage, cooked or boiled meat, meat loaves, and similar products: *Provided,* All parts of such carcasses and parts which are so used are heated to a temperature not lower than 170°F. for a period of not less than 30 minutes, either before being used in or during the preparation of the finished product.

b) When product passed for cooking is used as an ingredient of a meat food product as contemplated in paragraph (*a*) of this section at least 50 per cent of the meat and meat by-product ingredient shall consist of product passed for cooking. This requirement shall not apply when the product passed for cooking has been previously cooked as specified in paragraph (*a*) of this section before being used as an ingredient of a meat food product.

§ **15.3 Disposal of Product Passed for Cooking, if not Handled According to This Part.** Product passed for cooking if not handled and processed under the provisions of this Part, shall be disposed of in accordance with Part 14 of this subchapter.

PART 16—MARKING, BRANDING, AND IDENTIFYING PRODUCTS

Sec.
16.1 Approval of abbreviations of marks of inspection.
16.2 Preparation of marking devices bearing inspection legend without advance approval prohibited; exception.
16.3 Use of inspection legend prohibited except under supervision of division employee.

§ **16.4 Brands and Marking Devices to be Approved by Chief of Division; Control of Brands, etc.** Official establishments shall furnish such ink brands, burning brands, and like devices for marking product as the chief of division may require. The mark of inspection on such a device shall be in the circular form as a facsimile of one of the official brands, using the size best suited for the purpose intended. In advance of manufacture, complete and accurate descriptions and designs of the same shall be submitted to and approved by the chief of division. Every such brand and device which bears the inspection legend shall be delivered

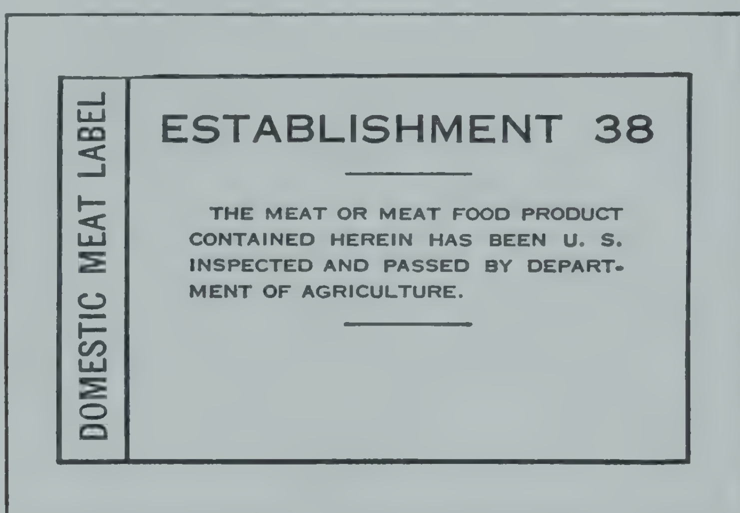
into the custody of the inspector in charge of the establihsment, and shall be used only under the supervision of a division employee. When not in use for marking inspected and passed product, all such brands and devices bearing the inspection legend shall be kept locked in properly equipped lockers or compartments, the keys of which shall not leave the possession of a division employee.

16.5 Articles not to be removed from establishments unless marked in accordance with regulations.
16.6 Marks of inspection to be carefully applied.
16.7 Branding ink to be furnished by establishment; approval by division, color.
16.8 Control and use of brands and marking devices furnished by division.

16.9 Brands and marking devices not to be false or misleading; style and size of lettering.
16.10 Carcasses, primal parts, and products; marking with inspection legend.
16.11 Moving and handling of primal parts from one establishment to another.
16.12 Handling of products too small to be marked with brand.
16.13 Marking of meat food products in casings.
16.14 Marking product with the list of ingredients.

§ **16.15 Marking of Shipping Containers; Domestic Meat Label.** (*a*) Except as provided in this part and Part 25 of this subchapter, when any inspected and passed product for domestic commerce is moved from an official establishment, the shipping container shall bear an approved mark of inspection, as prescribed in Part 17 of this subchapter, or an approved domestic meat label, whichever is appropriate. The domestic meat label shall be printed with black ink on white paper of good quality, shall be $2\frac{3}{4}$ by 4 inches in size, and shall be in form and substance as illustrated below, except that the name and address of the establishment, or the name only, may also be printed on the label, at the bottom thereof:

b) When any inspected and passed product is moved from a place having market inspection, as provided under this subchapter, the shipping container shall bear such mark as is required by the chief of division.



c) When any product prepared in an official establishment for domestic commerce has been inspected and passed and is enclosed in a cloth wrapping as a shipping container, such wrapping may bear, in lieu of the domestic meat label, the inspection legend and establishment number applied by the $2\frac{1}{2}$-inch rubber brand. The domestic meat label may also be omitted in those cases in which the inspection legend and establishment number on the articles themselves are clearly legible through the wrapping or the wrapping is labeled in accordance with Part 17 of this subchapter.

d) The shipping or outside containers of products for export shall be marked in compliance with Part 24 of this subchapter.

§ **16.16 Tank Cars of Edible Products.**

§ **16.17 Transferring Inspected and Passed Product for Export.**

§ **16.18 Denaturing of Inedible Grease, etc.; Marking "Inedible."**

PART 17—LABELING

§ **17.1 Labeling Required; Supervision by Division Employee.** (*a*) When, in an official establishment, any inspected and passed product is placed or packed in any can, pot, tin, canvas, or other receptacle or covering constituting an im-

mediate or true container, there shall be affixed to such container or covering a label as hereinafter described in this Part: *Provided*, That plain wrappings for fresh meat, such as dressed carcasses and primal parts thereof, which are used solely to protect the product against soiling or excessive drying during transportation or storage need not bear a label: *Provided further*, That uncolored transparent coverings, such as cellophane, which bear no printed or graphic matter and which enclose any unpackaged or packaged product bearing all required markings need not bear a label if the required markings are clearly legible through such coverings: *Provided further*, That animal and transparent artificial casings bearing no marks or printed features other than those required under Part 16 of this subchapter need not bear additional labeling: *And provided further*, That stockinettes used as "operative devices," such as those applied to cured meats in preparation for smoking, need not bear labels whether or not such stockinettes are removed following completion of the operations for which they were applied.

b) Folders and similar coverings made of paper or like material, which do not completely enclose the product and which bear any printed word or statement, shall bear all features required on a label for an immediate or true container.

c) No container or covering which bears or is to bear a label shall be filled, in whole or in part, except with product which has been inspected and passed in compliance with this subchapter, which is sound, healthful, wholesome, and fit for human food, and which is strictly in accordance with the statements on the label. No such container or covering shall be filled, in whole or in part, and no label shall be affixed thereto, except under the supervision of a division employee.

§ 17.2 Labels: What to Contain, When and How Used. (*a*) Labels within the meaning of this part shall include any printing, lithographing, embossing, or other marking on labels, stickers, seals, wrappers, or receptacles.

b) Labels shall contain, prominently and informatively displayed, (1) the true name of the product; (2) the word "ingredients" followed by a list of the ingredients, when the product is fabricated from two or more ingredients. except in the case of products for which definitions and standards of identity have been prescribed under Part 28 of this subchapter; (3) the name and place of business of the manufacturer, packer, or person for whom the product is prepared; (4) an accurate statement of the quantity of contents; and (5) an inspection legend and the number of the establishment in the form shown herewith, on that portion of the label featuring the name of the product, or, when there are two or more panels, then on the principal display panels: *Provided*, That the name and place of business of the manufacturer, packer, or person for whom the product was prepared and the statement of quantity of contents may be omitted from labels for product not required to be labeled under § 17.1: *Provided further*, That the establishment number may be omitted from the labels on cartons used as outer containers of edible fats, such as lard and oleomargarine, when such articles are enclosed in wrappers which bear an inspection legend and establishment number; and from a label lithographed directly on a can bearing the embossed or lithographed establishment number: *And provided further*, That a metal container on which an inspection legend is embossed or lithographed may, with the approval of the chief of division, bear an inspection legend of different design and in abbreviated form.

1) The name of a product shall be the common name, if any, and one which clearly and completely identifies the article. Product which has been prepared by salting, smoking, drying, cooking, chopping, and the like shall be so described on the label unless the name on the article implies, or the manner of packaging shows, that the product was subjected to such procedure or procedures. The unqualified terms "meat," "meat by-product," "meat food product," and terms common to the meat industry but not to consumers such as "picnic," "butt," "cala," "square," "loaf," "spread," "delight," "roll," "plate," "luncheon," and "daisy" shall not be used as names of articles unless accompanied with terms descriptive of the product or with a list of ingredients.

2) The list of ingredients shall appear as part of or in addition to the true name of the product and shall show the common or usual names of the ingredients arranged in the order of their predominance, except that spices may be designated as "spices" or "flavorings," and flavorings (including essential oils, oleoresins, and other spice extractives) may be designated as "flavorings" without naming each. The name of an ingredient shall not be a collective name but shall be a specific name, as, for example, "beef," "pork," "beef tripe," "sheep livers," "pork snouts," "flour," "corn flour," "potato flour," "water," "dried skim milk," "tomato puree," and "beef broth": *Provided*, That when a product is coated with pork fat, gelatin, or other approved substance and a specific declaration of such coating appears in connection with the name of product, the ingredient statement need not make reference to the ingredients of such coating: *And provided further*, That when the label bears the designation "compound" or "shortening" the term "animal and vegetable fats" or" vegetable and animal fats" may be employed to designate the ingredients of mixtures of such edible fats. "Animal fats" as used herein means inspected and passed fat derived from cattle, sheep, swine, or goats.

3) The name of the manufacturer or packer may appear without qualification on the label or the contanier of product. When the name of the manufacturer or packer is not that under which inspection is granted at the establishment but is the name of a tenant operating in the establishment, full information identifying the tenant and the scope of his operations shall be furnished to the chief of division. When product is not prepared by the person whose name appears on the label, the name shall be qualified by a phrase which reveals the connection such person has with such product, as for example, "Prepared for * * *."

4) The statement of quantity shall represent in terms of avoirdupois weight or liquid measure the quantity of product in the package (exclusive of materials packed with it) except as provided for in § 17.7. When no general consumer usage to the contrary exists, the statement shall be in terms of liquid measure, if the product is liquid, or in terms of weight if the product is solid, semisolid, viscous, or a mixture of solid and liquid. Unless the statement is so qualified as to show that it expresses the minimum quantity, it shall be taken to express the actual quantity. When the statement expresses the minimum quantity, no variation below the stated minimum shall be permitted, and variations above the stated minimum shall be no greater than consistent with filling the container to the stated minimum in accordance with good commercial practice. When the statement expresses actual quantity, variations incident to packing in accordance with good commercial practice shall be allowed but the average shall not be less than the quantity stated: *Provided*, That packages of product having a capacity of less than one-half ounce avoirdupois or less than one-half fluid ounce shall not be required to be labeled with the statement of the quantity of contents.

c) Stencils, box dies, inserts, tags, and like devices shall not bear an inspection legend or any abbreviation or representation thereof: *Provided*, That wooden boxes of light material, having a maximum capacity of 5 pounds and fiber-board containers may, upon approval by the chief of division, have an inspection legend and establishment number imprinted thereon.

d) The establishment number shall be either embossed or lithographed on all sealed metal containers of inspected and passed product filled in an official establishment, except that such containers which bear labels lithographed directly on the can and in which the establishment number is incorporated need not have the establishment number embossed or lithographed thereon. Labels shall not be

affixed to containers so as to obscure the embossed or lithographed establishment number.

e) When any product is placed in a carton or in a wrapper of paper or cloth or in such other labeled container or covering as the chief of division may approve, an inspection legend and the establishment number, in form and substance as specified in paragraph (*b*) of this section, may be embodied on a sticker to be securely and prominently affixed, along with the name of product, at a place on the label reserved and designated for the purpose. In case there are two or more display panels featuring the name of product, the inspection sticker shall be affixed to the principal panel or panels. The inspection sticker shall not be used without the approval of the chief of division and shall be affixed to the label under the supervision of a division employee.

§ **17.3 Labels to Conform with Definitions and Standards of Identity.** When inspected and passed products are labeled with the names of, or are represented as, articles for which definitions and standards of identity have been prescribed under Part 28 of this subchapter, the labels shall conform to such definitions and standards.

§ **17.4 Labels to be Approved by Chief of Division.** (*a*) Except as provided in paragraph (*d*) of this section no label shall be used on any product until it has been approved in its final form by the chief of division. For the convenience of the establishment sketches or proofs of new labels may be submitted in triplicate through the inspector in charge to the division for approval and the preparation of finished labels deferred until such approval is obtained. All finished labels shall be submitted in quadruplicate through the inspector in charge to the division for approval.

b) In case of lithographed labels, paper take-offs in lieu of sections of the metal containers shall be submitted for approval. Such paper take-offs shall not be in the form of a negative but shall be a complete reproduction of the label as it will appear on the package, including any color scheme involved. In case of fiber containers, printed layers, such as the kraft paper sheet, shall be submitted for approval in lieu of the complete container.

c) Inserts, tags, liners, pasters, and like devices containing printed or graphic matter and for use on, or to be placed within, containers and coverings of product shall be submitted for approval in the same manner as provided for labels in paragraph (*a*) of this section, except that inspectors in charge may permit use of such devices which contain no reference to product and bear no misleading feature.

d) Stencils, labels, box dies, and brands may be used on shipping containers and on such immediate containers as tierces, barrels, drums, boxes, crates, and large-size fiberboard containers provided the markings are applicable to the product, are not false or deceptive, and are used with the approval of the inspector in charge. The inspection legend for use in combination with such markings shall be approved by the chief of division whether the legend is applied in the form illustrated in § 17.2 or by means of a domestic meat label.

§ **17.5 Inspector in Charge to Permit Certain Modifications of Approved Labels.** The inspector in charge may permit the use of approved labels or other markings modified as follows provided the labeling or marking as modified is so used as not to be false or deceptive:

a) When all features of the label or marking are proportionately enlarged and the color scheme remains the same.

b) When changes are made in the figures denoting the quantity of contents or when there is substitution of such abbreviations as "lb." for "pound," "oz." for "ounce," or the word "pound" or "ounce" is substituted for the abbrevaition.

c) When a master or stock label is approved from which the name and address of the distributor are omitted and such name and address are applied before being used. The words "prepared for" or similar statement must be shown together with the blank space reserved for the insertion of the name and address when such labels are offered or approval.

d) When, during Christman and other holiday seasons, wrappers or other covers bearing floral or foliage designs or illustrations of rabbits, chicks, fireworks, or other emblematic holiday designs are used with approved labels or markings. The use

of such designs will not make necessary the application of labeling not otherwise required.

(e) When there is a slight change in arrangement of directions pertaining to the opening of cans or the serving of the product.

(f) When there is a change in the order of predominance of the ingredients on the label corresponding with a change in the formula used to prepare the product: *Provided*, That no new ingredients are added and none are omitted. Nothing in this paragraph shall be construed to modify any requirement of these regulations which provides either minimum or maximum limits for the use of certain ingredients.

§ 17.6 Approved Labels to be Used Only on Products to Which They are Applicable. Labels shall be used only on products for which they are approved. They shall not be applied to any product the container or covering of which bears any statement that is false or misleading or is so made, formed, or filled as to be deceptive or misleading.

§ 17.7 Product for Foreign Commerce; Printing Labels in Foreign Language Permissible. Labels to be affixed to packages of product for foreign commerce may be printed in a foreign language and may show the statement of the quantity of contents in accordance with the usage of the country to which exported. Deviations from the form of labeling required under this subchapter may be approved by the chief of division: *Provided*, (1) That the proposed labeling accords to the specifications of the foreign purchaser, (2) That it is not in conflict with the laws of the country to which it is intended for export, and (3) That the outside of the shipping package is labeled to show that it is intended for export; but if such product is sold or offered for sale in domestic commerce all the requirements of this subchapter apply. The inspection legend and the establishment number shall in all cases appear in English but, in addition, may appear literally translated in a foreign language.

§ 17.8 False or Deceptive Names; Established Trade Names; False Indication of Origin or Quality; Use of Names of Countries, States, etc.; "Farm," "Country," etc., Qualified by Word "Style"; Labeling of Lard, Oleo Oil, Oleo Stearin, etc. (*a*) No product, and no container thereof, shall be labeled with any false or deceptive name, but established trade names which are usual to such articles and are not false or deceptive and which have been approved by the chief of division may be used.

(*b*) A label for product which is in imitation of another food shall bear the word "imitation" immediately preceding the name of the food imitated and in the same size and style of lettering as in that name and immediately thereafter the word "ingredients" and the names of the ingredients arranged in the order of their predominance.

(*c*) No statement, word, picture, design, or device which conveys any false impression or gives any false indication of origin or quality shall appear on any label. For example:

(1) Terms having geographical significance with reference to a locality other than that in which the product is prepared may appear on the label only when qualified by the word "style," type," or "brand," as the case may be, in the same size and style of lettering as in the geographical term and accompanied with a prominent qualifying statement identifying the country, State, Territory, or locality in which the product is prepared, using terms appropriate to effect the qualification. When the word "style" or "type" is used, there must be a recognized style or type of product identified with and peculiar to the locality represented by the geographical term and the product must possess the characteristics of such style or type, and the word "brand" shall not be used in such a way as to be false or deceptive: *Provided*, That a geographical term which has come into general usage as a trade name and which has been approved by the chief of division as being a generic term may be used without the qualifications provided for in this paragraph. The terms "frankfurter," "vienna," "bologna," "lebanon bologna," braunschweiger," "thuringer," "genoa," "leona," "berliner," "holstein," "goteborg," "milan," "polish," and their modifications, as applied to sausages, the terms "brunswick," and "irish" as applied to stews, and the term "boston" as applied to pork shoulder butts, need not be

accompanied with the word "style," "type," or "brand" or a statement identifying the locality in which the product is prepared.

2) Such terms as "farm," "country," and the like shall not be used on labels in connection with products unless such products are actually prepared on the farm or in the country: *Provided*, That if the product is prepared in the same way as on the farm or in the country these terms, if qualified by the word "style" in the same size and style of lettering, may be used: *Provided further*, That the term "farm" may be used as part of a brand designation when qualified by the word "brand" in the same size and style of lettering, and followed with a statement identifying the locality in which the product is prepared. Sausage containing cereal shall not be labeled "farm style" or "country style," and lard not rendered in an open kettle shall not be designated as "farm style" or "country style."

3) The requirement that the label shall contain the name and place of business of the manufacturer, packer, or distributor shall not be considered to relieve any establishment from the requirement that its label shall not be misleading in any particular.

4) The term "spring lamb" or "genuine spring lamb" is applicable only to carcasses of new-crop lambs slaughtered during the period beginning in March and terminating not beyond the close of the week containing the first Monday in October.

5) Coverings shall not be of such color, design, or kind as to be misleading or deceptive with respect to color, quality, or kind of product to which they are applied. For example, transparent or semitransparent coverings for such articles as sliced bacon or pork sausage shall not bear lines or other designs of red or other color which give a false impression of leanness of the product.

6) The word "fresh" shall not be used on labels to designate product which contains any sodium nitrate, sodium nitrite, potassium nitrate, or potassium nitrite, or which has been salted for preservation.

7) The words "spice," "spices," and "spiced," without qualification, shall not be used unless they refer to genuine natural spices.

8) As used on labels of meat or product, the term "gelatin" shall mean (i) the jelly prepared in official establishments by cooking pork skins, tendons, or connective tissue from inspected and passed product, and (ii) dry commercial gelatin or the jelly resulting from its use.

9) Product (other than canned product) labeled with the term "loaf" as its name or part of its name shall be prepared in loaf form with sufficient stability to withstand handling before being placed in a wrapper, casing, or the like.

10) The term "baked" shall apply only to the product which has been cooked by the direct action of dry heat and for a sufficient time to permit the product to assume the characteristics of a baked article, such as the formation of a brown crust on the surface, rendering out of surface fat, and the caramelization of the sugar if applied. Baked loaves shall be heated to a temperature of at least 160°F. and baked pork cuts shall be heated to an internal temperature of at least 170°F.

11) When product such as loaves is browned by dipping in hot edible oil or by a flame, its label shall state such fact, the words "Browned in Hot Cottonseed Oil" or "Browned by a Flame," as the case may be, appearing as part of the name of product.

12) The term "meat" and the names of particular kinds of meat, such as beef, veal, mutton, lamb, and pork, shall not be used in such manner as to be misleading or deceptive.

13) The word "ham," without any prefix indicating the species of animal from which derived, shall be used on labels only in connection with pork hams. Ham shanks as such or ham shank meat as such or the trimmings accruing in the trimming and shaping of hams shall not be labeled "ham" or "ham meat" without qualification. When used in connection with a chopped product the term "ham" or "ham meat" shall not include the skin.

14) The term "shankless" and "hockless" shall apply only to hams and pork shoulders from which the shank or hock has been completely removed, thus eliminating the entire tibia and fibula, or radius and ulna, respectively, together with the overlying muscle, skin, and other tissue.

15) Such terms as "meat extract" or "extract of beef" without qualification shall not be used on labels in connection with products prepared from organs or parts of the carcass other than fresh meat. Extracts prepared from any parts of the carcass other than fresh meat shall not be labeled "meat extract" but may be properly labeled with the true name of the parts from which prepared. In the case of extract in fluid form, the word "fluid" shall also appear on the label, as, for example, "fluid extract of beef." Meat extract shall contain not more than 25 per cent of moisture. Fluid extract of meat shall contain not more than 50 per cent of moisture.

16) When cereal, vegetable starch, starchy vegetable flour, soya flour, dried milk, or dried skim milk is added to sausage within the limits prescribed under Part 18 of this subchapter, there shall appear on the label in a prominent manner, contiguous to the name of the product, the name of each such added ingredient, as, for example, "cereal added," "with cereal," "potato flour added," "cereal and potato flour added," "soya flour added," "dried skim milk added," "cereal and dried skim milk added," as the case may be.

17) When any product is enclosed in a container along with a packing substance such as brine, vinegar, or agar jelly, a declaration of the packing substance shall be printed prominently on the label in connection with the name of product, as, for example, "frankfurts packed in brine," "lamb tongue packed in vinegar," or "beef tongue packed in agar jelly," as the case may be. The statement of the quantity of contents shall represent the weight of the drained product when removed from the container to the exclusion of the packing substance. The packing substance shall not be used in such a manner as will result in the container being so filled as to be misleading.

18) The term "lard" is applicable only to the fat rendered from fresh, clean, sound, fatty tissues from hogs in good health at the time of slaughter, with or without lard stearin or hydrogenated lard. The tissues do not include bones, detached skin, head skin, ears, tails, organs, windpipes, large blood vessels, scrap fat, skimmings, settlings, pressings, and the like, and are reasonably free from muscle tissue and blood.

19) The term "leaf lard" is applicable only to lard prepared from fresh leaf fat.

20) The term "rendered pork fat" is applicable to the fat other than lard, rendered from clean, sound carcasses, parts of carcasses, or edible organs from hogs in good health at the time of slaughter, except that stomachs, bones from the head, and bones from cured or cooked pork are not included. The tissues rendered are usually fresh, but may be cured, cooked, or otherwise prepared and may contain some meat food products. Rendered pork fat may be hardened by the use of lard stearin and/or hydrogenated lard and/or rendered pork fat stearin and/or hydrogenated rendered pork fat.

21) When lard or hardened lard is mixed with rendered pork fat or hardened rendered pork fat, the mixture shall be designated as "rendered pork fat" or "hardened rendered pork fat," as the case may be.

22) Oil, stearin, or stock obtained from beef or mutton fats rendered at a temperature above 170°F. shall not be designated as "oleo oil," "oleo stearin," or "oleo stock," respectively.

23) When not more than 20 per cent of beef fat, mutton fat, oloe stearin, vegetable stearin, or hardened vegetable fat is mixed with lard or with rendered pork fat, there shall appear on the label, contiguous to and in the same size and style of lettering as the name of product, the words "beef fat added," "mutton fat added," "oleo stearin added," "vegetable stearin added," or "hardened vegetable fat added," as the case may be.

24) The designation "vegetable fat" is applicable to vegetable oil, vegetable stearin, or a combination of such oil and stearin, whereas the designations "vegetable oil" and "vegetable stearin" shall be applicable only to the oil and the stearin, respectively.

25) No rendered edible animal fat or mixture of fats containing rendered edible animal fat shall contain added water, except that puff-pastry shortening may contain not more than 10 per cent of water, and oleomargarine may contain water within the limits prescribed under Part 28 of this subchapter.

26) Containers of edible rendered animal fats and mixtures of edible fats containing animal fats shall, before or immediately after filling, be legibly marked with the true name of the product.

27) Product labeled "chili con carne" shall contain not less than 40 per cent of meat computed on the weight of the fresh meat. Head meat, cheek meat, and heart meat exclusive of the heart cap may be used to the extent of 25 per cent of the meat ingredient under specific declaration on the label. The mixture may contain not more than 8 per cent, individually or collectively, of cereal or soya flour.

28) Product labeled "chili con carne with beans" shall contain not less than 25 per cent of meat computed on the weight of the fresh meat. Head meat, cheek meat, and heart meat exclusive of the heart cap may be used to the extent of 25 per cent of the meat ingredient under specific declaration on the label.

29) Product labeled "hash" shall contain not less than 35 per cent of meat computed on the weight of the cooked and trimmed meat. The weight of the cooked meat used in this calculation shall not exceed 70 per cent of the uncooked weight of the fresh meat. Corned beef hash shall not be made with cereal, vegetable flour, dried skim milk, or similar substances. Beef cheek meat and beef head meat from which the overlying glandular and connective tissues have been removed, and beef heart meat, exclusive of the heart cap, may be used individually or collectively to the extent of 5 per cent of the meat ingredient in the preparation of corned beef hash. When beef cheek meat, beef head meat, and beef heart meat are used in the preparation of this product, their presence shall be reflected in the statement of ingredients as required by Part 17 of this subchapter.

30) Products labeled as meat stews, for example, "beef stew," "lamb stew," and the like, shall contain not less than 25 per cent of meat computed on the weight of the fresh meat.

31) Tamales shall contain not less than 25 per cent of meat computed on the weight of the fresh meat in relation to the ingredients of the tamales to the exclusion of the ingredients of the gravy or sauce in which the tamales are packed. When tamales are packed in gravy or sauce, that constituent shall be declared prominently as part of the name of the product.

32) Spaghetti with meat balls and sauce, spaghetti with meat and sauce, and similar product, shall contain not less than 12 per cent of meat computed on the weight of the fresh meat. The presence of the sauce or gravy constituent shall be declared prominently on the label as part of the name of the product. Meat balls may be prepared with not more than 12 per cent, singly or collectively, of farinaceous material, soya flour, dried skim milk, and the like.

33) Spaghetti sauce with meat shall contain not less than 6 per cent of meat computed on the weight of the fresh meat.

34) Scrapple shall contain not less than 40 per cent of meat and/or meat by-products computed on the basis of the fresh weight, exclusive of bone. The meal or flour used may be derived from grain and/or soybeans.

35) Hamburger shall consist of chopped fresh beef, with or without the addition of beef fat as such and/or of seasoning, and shall not contain more than 30 per cent of fat.

36) Liver sausage, liver loaf, liver paste, liver cheese, liver pudding, liver spread, and the like shall contain not less than 30 per cent of liver computed on the weight of the fresh liver.

37) Product labeled "ham spread," "tongue spread," and the like shall contain not less than 50 per cent of the meat ingredient named (to the exclusion of other meat and meat by-product except fat), computed on the weight of the fresh meat.

38) Deviled ham may contain added ham fat: *Provided*, That the total fat content shall not exceed 35 per cent of the finished product. The moisture content of deviled ham, deviled tongue, and the like, shall not exceed that of the fresh unprocessed meat.

39) Potted meat food product and deviled meat food product shall not contain cereal, vegetable flour, dried skim milk or similar substance. The amount of water added to potted meat food product and deviled meat food product shall be limited to that necessary to replace moisture lost during processing.

40) Pork sausage and breakfast sausage, whether fresh, smoked, or canned, shall not be made with product which, in the aggregate for each lot, contains more than 50 per cent trimmable fat; that is, fat which can be removed by thorough, practicable trimming and sorting.

41) Cooked, cured, or pickled pigs feet, pigs knuckles, and the like, shall be labeled to show that the bones remain in the product, if such is the case. The designation "semiboneless" shall not be used if less than 50 per cent of the total weight of bones has been removed.

42) Canned product labeled "Corned Beef" and canned product labeled "Roast Beef Parboiled and Steam Roasted" shall be prepared so that the weight of the finished product shall not exceed 70 per cent by weight of the fresh beef, plus salt and flavoring material included in the product. Beef cheek meat and beef head meat from which the overlying glandular and connective tissues have been removed, and beef heart meat, exclusive of the heart cap, may be used individually or collectively to the extent of 5 per cent of the meat ingredient in the preparation of canned product labeled "Corned Beef" and canned product labeled "Roast Beef Parboiled and Steam Roasted." When beef cheek meat, beef head meat, and beef heart meat are used in the preparation of these products, their presence shall be reflected in the statement of ingredients as required by Part 17 of this subchapter.

43) When monoglycerides and diglycerides are added to rendered animal fat or a combination of such fat and vegetable fat, there shall appear on the label in a prominent manner and contiguous to the name of the product a statement such as "With Monoglycerides and Diglycerides," "Monoglycerides and Diglycerides Added," "With Diglycerides and Monoglycerides" or "Diglycerides and Monoglycerides Added" as the case may be.

§ 17.9 Labeling Product Prepared with Artificial Coloring, Artificial Flavoring, or Preservative. Product which bears or contains any artificial coloring, artificial flavoring, or preservative shall bear labeling stating that fact.

a) Artificial coloring of edible fats shall be declared on the label in a prominent manner and contiguous to the name of the product by the words "artificially colored."

b) When product is placed in casings to which artificial coloring is applied, as permitted under this subchapter, there shall appear on the label, in a prominent manner and contiguous to the name of the product, the words "artificially colored": *Provided*, That if the casing is removed from the product at the establishment and there is evidence of the artificial coloring on the surface of the product, there shall appear on the label in a prominent manner and contiguous to the name of the product, the words "artificially colored": *Provided further*, That when the casing is colored prior to its use as a covering for product, there shall appear on the label in a prominent manner and contiguous to the name of the product the words "casing colored": but *Provided further*, That colored opague artificial casings need not be marked with the words "casing colored."

c) When any artificial flavoring is permitted to be added to product there shall appear on the label in prominent letters and contiguous to the name of the product the words "artificially flavored," and the ingredient statement shall identify it as an artificial flavoring.

d) When a preservative is added to product, as permitted under this subchapter, there shall appear on the label in prominent letters and contiguous to the name of the product a statement showing that fact and identifying the preservative and the percentage amount.

e) Containers of meat packed in borax or other preservative for export to a foreign country which permits the use of such preservative shall, at the time of packing, be marked "for export," followed on the next line by the words "packed in preservative," or such equivalent statement as may be approved for this purpose by the chief of division, and directly beneath this there shall appear the word "establishment" or abbreviation thereof, followed by the number of the establishment at which the product is packed. The complete statement shall be applied in a conspicuous location and in letters not less than 1 inch in height.

§ **17.10 Reuse of Inspection Marks; Reuse of Containers Bearing Marks of Inspection, Labels, etc.; Requirements Regarding.** (*a*) No inspection legend which has been previously used shall be used again for the identification of any product, except as provided for in paragraph (*b*) of this section.

b) All stencils, marks, labels, or other devices on previously used containers, whether relating to any product or otherwise, shall be removed or obliterated before such containers are used for any product, unless such stencils, marks, labels, or devices correctly indicate the article to be packed therein and such containers are refilled under the supervision of a division employee.

§ **17.11 Labeling, Filling of Containers, Handling of Labeled Products to be Only in Compliance with Regulations.** (*a*) All labeling of product required to be inspected by division employees shall be in compliance with the regulations in this subchapter.

b) No person shall apply or affix, or cause to be applied or affixed, any label to any product prepared or received in an official establishment, or to any container thereof, except in compliance with the regulations in this subchapter.

c) No person shall, in an official establishment, fill or cause to be filled, in whole or in part, any container with any product required by the regulations in this subchapter to bear a label, except in compliance with the regulations in this subchapter.

d) No person shall remove or cause to be removed from an official establishment any product bearing a label unless such label be in compliance with the regulations in this subchapter.

§ **17.12 Relabeling Product, Requirements Regarding.** When it is claimed by an official establishment that some of its labeled product which has been transported to a location other than an official establishment, is in need of relabeling on account of the labels having become mutilated or otherwise damaged, the requests for relabeling the product shall be sent to the chief of division and accompanied with a statement of the reasons therefor. Labeling material intended for relabeling inspected and passed product shall not be transported from an official establishment until permission has been received from the chief of division. The relabeling of inspected and passed product with official labels shall be done under the supervision of an inspector of the division. The establishment shall reimburse the division, in accordance with regulations of the United States Department of Agriculture, for any cost involved in supervising the relabeling of such product.

§ **17.13 Distribution of Labels Bearing an Inspection Legend.** Labels, wrappers, and cartons bearing an inspection legend with or without the establishment number may be transported from one official establishment to another: *Provided*, Such shipments are made with the permission and under the supervision of the inspector in charge at the station of origin, who will notify the inspector in charge at destination concerning the date of shipment of the labeling material and the character and quantity of the materials involved. No such material shall be used at the establishment to which it is shipped unless it conforms with the requirements of this subchapter.

§ **17.14 Rescindment of Label Approvals.** Once a year, or oftener if necessary, each official establishment should submit to the chief of division, in quadruplicate, a list of approvals for labels that have become obsolete, accompanied with a statement that such approvals are no longer desired. The approvals shall be identified by the number, the date of approval, and the name of product or other designation showing the class of material.

PART 18—REINSPECTION AND PREPARATION OF PRODUCTS

§ **18.1 Reinspection of Products; Frozen Products.** (*a*) All products, whether fresh, cured, or otherwise prepared, even though previously inspected and passed, shall be reinspected by division employees as often as may be necessary in order to ascertain whether they are sound, healthful, wholesome, and fit for human food at the time they leave official establishments. If upon reinspection any article is found to have become unsound, unhealthful, unwholesome, or in any way unfit for human food, the original mark, stamp, or label thereon shall be removed or defaced and the article condemned: *Provided*, That:

(1) If an article becomes soiled or unclean by falling on the floor or in any other accidental way, it may be cleaned (including trimming, if necessary) and presented for reinspection.

(2) When an article is found to be affected by any unsound or unwholesome condition designated by the chief of division as being capable of rehandling by approved methods for food purposes, the official establishment may be permitted to rehandle if necessary steps are immediately taken in a manner prescribed by him. Included are such conditions as articles found to have absorbed a foreign odor, to contain mold or similar substance, and rendered animal fats in which there is present tank water in first stages of sourness. If upon final inspection the article is found to be sound and wholesome it shall be passed for human food; otherwise it shall be condemned.

(*b*) Care shall be taken to see that product is in good condition when placed in freezers. If there is doubt as to the soundness of any frozen product, the inspector will require the defrosting and reinspection of a sufficient quantity thereof to determine its actual condition.

(1) Product, such as pork tenderloins, brains, sweetbreads, stews, chop suey, *etc.*, shall not be packed in hermetically sealed metal or glass containers, unless subsequently heat processed or otherwise treated to preserve the product in a manner approved by the chief of division.

(2) Frozen product may be defrosted in water or pickle in a manner and with the use of facilities which are acceptable to the inspector in charge. Before such product is defrosted, a careful examination shall be made to determine its condition. If necessary, this examination shall include defrosting of representative samples by means other than in water or pickle.

(*c*) Attention should be given particularly to the first draw-off from the bottoms of tank cars where a tank-water-sour condition is sometimes found.

§ 18.2 **Tagging Products "U. S. Retained" on Reinspection; Disposition Thereof.** A "U. S. retained" tag shall be placed by a division employee at the time of reinspection on all products or the containers thereof which are suspected on reinspection at an official establishment or in the possession of such establishment of being unsound, unhealthful, unwholesome, or in any way unfit for human food. The employee who affixes th tag shall record the tag number and the kind and amount of the article retained. Such tag shall accompany such article to the retaining room or other special place for final inspection. When the final inspection is made, if the article is condemned, the original mark, stamp, or label thereon shall be removed or defaced and the inspector shall stamp on or write across the face of the retained tag the phrase "U. S. inspected and condemned," and this tag shall accompany such article into the tank. The inspector shall make a complete record of the transaction and shall report his action to the inspector in charge. If, however, upon final inspection the article is passed for food, the inspector shall remove the retained tag, record the transaction, and report his action to the inspector in charge.

§ 18.3 **Unsound Product Bearing Inspection Mark Found Outside of Official Establishments.** Division employees shall inform local representatives of the Food and Drug Administration, or responsible State or municipal officials, and report to the chief of division regarding any product which bears, or the container of which bears, the inspection legend, discovered by them outside of official establishments, and which is unsound, unhealthful, unwholesome, or in any way unfit for human food.

§ 18.4 **Product Entering Official Establishments; Identification as Inspected and Passed; Disposition; Shipping in Commerce.** (*a*) Except as provided in Part 12 of this subchapter, no product shall be brought into an official establishment unless it has been previously inspected and passed by a division employee, nor unless it can be identified by marks, seals, brands, or labels as having been so inspected and passed, nor, except as provided in Part 27 of this subchapter, if it has been processed elsewhere than in an official establishment. All products brought into an official establishment in compliance with the regulations in this subchapter shall be identified and reinspected at the time of receipt, and be subjected to further reinspection in such manner and at such times as may be deemed

necessary. If upon such reinspection any article is found to be unsound, unhealthful, unwholesome, or otherwise unfit for human food, the original mark, stamp, or label shall be removed or defaced and the article condemned.

b) Any product which has been inspected and passed under the regulations in this subchapter and which bears the inspection legend may be shipped in interstate or foreign commerce, provided it is sound, healthful, wholesome, and fit for human food and has not been processed, reprocessed, or changed elsewhere than in an official establishment in any manner so as to alter the character of the product.

§ **18.5 Designation of Places of Receipt of Returned Products for Reinspection.** Every official establishment shall designate, with the approval of the inspector in charge, a dock or place at which returned products shall be received, and such products shall be received only at such dock or place and shall be inspected there by a division employee before further entering the establishment.

§ **18.6 Processes to be Supervised; Containers, Equipment, Processes of Manufacture to be Clean and Sanitary; Substances to be Clean and Wholesome.** (*a*) All processes used in curing, pickling, rendering, canning, or otherwise preparing any product in official establishments shall be supervised by division employees. No fixtures or appliances, such as tables, trucks, trays, tanks, vats, machines, implements, cans, or containers of any kind, shall be used unless they are of such materials and construction as will not contaminate the product and are clean and sanitary. All steps in the processes of manufacture shall be conducted carefully and with strict cleanliness in rooms or compartments separate from those used for inedible products.

1) All containers which are intended to be hermetically sealed shall be washed as required under § 18.11 immediately before filling, except that the hermetically sealed cans in which lard is shipped may be examined immediately before being filled and if found to be acceptably clean, need not be washed.

2) Pumps, pipes, conductors, and fittings used to conduct milk, skim milk, cream, or mixtures of these in the manufacture of oleomargarine shall be of sanitary construction, with smooth inner and outer surfaces of noncorrosive material or coated with nickel, tin, or other approved material, readily demountable for cleaning, and shall be kept clean and sanitary.

3) Equipment may be used interchangeably for the preparation of lard and rendered pork fat which are to be labeled as such. The chief of division may grant permission for the restricted dual use of such equipment for the preparation of other products. The pipes and equipment used for edible fats shall be so arranged that the identity of the product will be maintained until the product is properly labeled.

4) The only animal casings that may be used as containers of product are those from cattle, sheep, swine, or goats.

5) Casings for products shall be carefully inspected by division employees. Only those which have been carefully washed and thoroughly flushed with clean water immediately before stuffing, are suitable for containers, are clean, and are passed on such inspection, shall be used.

6) Beef rounds, beef bungs, beef middles, beef bladders, hog bungs, hog middles, and hog stomachs which are to be used as containers of meat food product shall be presented for inspection turned with the fat surface exposed.

7) Portions of casings which show infestation with *Oesophagostomum* or other nodule-producing parasite, and weasands infested with the larvæ of *Hypoderma lineatum*, shall be rejected, except that when the infestation is slight and the nodules and larvæ are removed, the casing or weasand may be passed.

8) The fermenting of intestines is not permitted in official establishments. The stripping and sliming of intestines shall be performed in a clean manner.

9) Hog and sheep casings intended for use as containers of product may be treated by soaking in or applying thereto sound, fresh pineapple juice or a sound solution containing fresh pineapple juice or papain or bromelin or pancreatic extract to permit the enzymes contained in these substances to act on the casings to make them less resistant. The casings shall be handled in a clean and sanitary manner throughout and the treatment shall be followed by washing and flushing

the casings with water sufficiently to effectively remove the substance used and terminate the enzymatic action.

b) All substances and ingredients used in the manufacture or preparation of any product shall be clean, sound, healthful, wholesome, and otherwise fit for human food.

1) On account of the invariable presence of bone splinters, detached spinal cords shall not be used in the preparation of edible product other than for rendering where they constitute a suitable raw material.

2) Care shall be taken to remove bones and parts of bones from product which is intended for chopping.

3) Heads for use in the preparation of meat food products shall be split and the bodies of the teeth, the turbinated and ethmoid bones, ear tubes, and horn butts removed, and the heads then thoroughly cleaned.

4) Kidneys for use in the preparation of meat food products shall first be freely sectioned and then thoroughly soaked and washed. All detached kidneys, including beef kidneys detached with kidney fat, shall be inspected before being used in or shipped from the establishment.

5) Testicles if handled as an edible product may be shipped from the establishment as such, but they shall not be used as an ingredient of a meat food product.

6) Cattle paunches and hog stomachs for use in the preparation of meat food products shall be thoroughly cleaned on all surfaces and parts immediately after being emptied of their contents, which shall follow promptly their removal from the carcasses.

7) Tonsils shall be removed and shall not be used as ingredients of meat food products.

8) Hog blood shall not be used as an ingredient of meat food product. No blood which comes in contact with the surface of the body of an animal or is otherwise contaminated shall be collected for food purposes. Only blood from animals the carcasses of which are inspected and passed may be used for meat food products. The defibrination of blood intended for food purposes shall not be performed with the hands.

9) No prohibited dye, chemical, preservative, or other substance shall be brought into or kept in an official establishment for use as an ingredient of human food or animal feed.

10) Intestines shall not be used as ingredients of meat food products.

11) Clotted blood shall be removed from hog hearts before they are shipped from the establishment or used in the preparation of a meat food product.

§ **18.7 Use in Preparation of Meat Food Products of Chemicals, Preservatives, Coloring Matter; Addition of Cereal, Vegetable Starch, Dried Skim Milk, Water, etc., Substances Necessary for Refining.** (*a*) No product shall contain any substance which impairs its wholesomeness or which is not approved by the chief of division.

b) There may be added to products, with appropriate declaration as required under Parts 16 and 17 of this subchapter, common salt, sugar (sucrose), refined corn sugar (dextrose), wood smoke, a vinegar, flavorings, spices, sodium nitrate, sodium nitrite, potassium nitrate (saltpeter), and potassium nitrite.

c) Monoglycerides and diglycerides may be added to rendered animal fat or a combination of such fat and vegetable fat with appropriate declaration as required in Part 17 of this subchapter.

d) With appropriate declaration, as provided in Part 17 of this subchapter, the following preservatives may be added, in the amounts indicated, to rendered animal fat or a combination of such fat and vegetable fat:

1) Resin guaiac not to exceed $\frac{1}{10}$ of 1 per cent; or

2) Nordihydroguaiaretic acid not to exceed $\frac{1}{100}$ of 1 per cent; or

3) Tocopherols not to exceed $\frac{1}{100}$ of 1 per cent. (A 30 per cent concentration of tocopherols in vegetable oils shall be used when added as a preservative to products designated as "lard" or "rendered pork fat"); or

4) Lecithin: *Provided*, That nothing in this paragraph shall prevent the use of this substance as an emulsifier as approved by the chief of division; or

5) Citric acid not to exceed $\frac{1}{100}$ of 1 per cent; or

6) Citric acid not to exceed $\frac{5}{1000}$ of 1 per cent, or phosphoric acid not to exceed $\frac{5}{1000}$ of 1 per cent, in combination with not more than $\frac{1}{100}$ of 1 per cent of nordihydroguaiaretic acid; or

7) Propyl gallate not to exceed $\frac{1}{100}$ of 1 per cent; or

8) Propyl gallate not to exceed $\frac{1}{100}$ of 1 per cent in combination with not more than $\frac{5}{1000}$ of 1 per cent of citric acid; or

9) Thiodipropionic acid, dilauryl thiodipropionate, distearyl thiodipropionate or combinations thereof in quantities not to exceed $\frac{1}{100}$ of 1 per cent of thiodipropionic acid and $\frac{9}{100}$ of 1 per cent of either dilauryl thiodipropionate or distearyl thiodipropionate or combinations of the two; or

10) Butylated hydroxyanisole (a mixture of 2-tertiarybutyl-4-hydroxyanisole and 3-tertiarybutyl-4-hydroxyanisole) and combinations of butylated hydroxyanisole with nordihydroguaiaretic acid or propyl gallate with or without the addition of citric acid or phosphoric acid, may be added as preservatives to animal fats and shortenings containing animal fats. The quantities used shall not exceed $\frac{2}{100}$ of 1 per cent of butylated hydroxyanisole, or $\frac{1}{100}$ of 1 per cent of nordihydroguaiaretic acid plus $\frac{2}{100}$ of 1 per cent butylated hydroxyanisole or $\frac{1}{100}$ of 1 per cent of propyl gallate plus $\frac{2}{100}$ of 1 per cent of butylated hydroxyanisole. Citric acid or phosphoric acid, not to exceed $\frac{5}{1000}$ of 1 per cent may be added with butylated hydroxyanisole or with the combinations of butylated hydroxyanisole and nordihydroguaiaretic acid or propyl gallate.

e) To facilitate chopping and/or to dissolve the usual curing ingredients, water or ice may be used in the preparation of luncheon meat and meat loaf; however, the total amount of water used shall not exceed 3 per cent of the ingredients going into the preparation of the product and its presence shall be declared as required under Parts 16 and 17 of this subchapter.

f) Except as otherwise provided, sausage shall be prepared with meat, or meat and meat by-product, seasoned with condimental proportions of condimental substances.

g) Under appropriate declaration as required in Parts 16 and 17 of this subchapter, sausage may contain not more than $3\frac{1}{2}$ per cent, individually or collectively, of cereal, vegetable starch, starchy vegetable flour, soya flour, dried skim milk, or dried milk.

h) For the purpose of facilitating chopping and mixing, and under appropriate declaration as required under Parts 16 and 17 of this subchapter, water or ice may be used in the preparation of sausage which is not cooked, in an amount not to exceed 3 per cent of the total ingredients used. Sausage of the kind which is cooked, such as frankfurter, vienna, and bologna, may contain not more than 10 per cent of added water or moisture.

i) Bicarbonate of soda, caustic soda, sodium carbonate, diatomaceous earth, fuller's earth, carbon, acetic acid, tannic acid, agents used exclusively as catalyzers such as nickel preparations, and such other substances as may be approved by the chief of division, may be used in the preparation of rendered fats: *Provided*, That they are eliminated during the process of manufacture.

j) Caustic soda, sodium carbonate (soda ash or sal soda), trisodium phosphate, or sodium metasilicate, or a combination of these substances, or lime, or a combination of lime and sodium carbonate, and/or a solution of hydrogen peroxide, may be used in the preparation of tripe: *Provided*, That immediately following the treatment the tripe is thoroughly washed with clear water and the added substances removed.

k) The use of sodium nitrite, potassium nitrite, sodium nitrate, or potassium nitrate, or combinations of nitrite and nitrate, shall not result in the presence of more than 200 parts per million of nitrite in the finished product. Supplies of sodium nitrite and potassium nitrite and mixtures containing them must be kept securely under the care of a responsible employee of the establishment. The specific nitrite content of such supplies must be known and clearly marked accordingly. The maximum amounts of sodium nitrite and/or potassium nitrite which may be used are as follows:

1) 2 pounds in 100 gallons of pickle.

2) 1 ounce for each 100 pounds of meat in dry salt, dry cure, or box cure.

3) ¼ ounce in 100 pounds of chopped meat and or meat by-products.

l) Harmless synthetic flavoring may be added to products for which they are approved by the chief of division, and declared as "artificial flavoring," as required under Parts 16 and 17 of this subchapter.

m) Coloring matter and dyes which are approved by the chief of division when declared as required under Parts 16 and 17 of this subchapter may be mixed with rendered fats, applied to animal and artificial casings, and applied to such casings enclosing product: *Provided*, That there is no penetration of the coloring matter or dye into the product. The presence of a visible ring of dyed product appearing around the periphery of the cut surface is evidence of penetration.

The following coloring matters and dyes are acceptable:

1) The natural coloring matters alkanet, annatto, carotene, cochineal, green chlorophyl, saffron, and tumeric.

2) Coal-tar dyes as follows, subject also to certification by the manufacturer and the furnishing of authoritative evidence to the inspector in charge that the dyes have been certified under the Federal Food, Drug, and Cosmetic Act for use in connection with foods:

Name	*Former name*
FD&C Blue No. 1	Brilliant Blue FCF
FD&C Blue No. 2	Indigotine
FD&C Green No. 1	Guinea Green B
FD&C Green No. 2	Light Green SF Yellowish
FD&C Green No. 3	Fast Green FCF
FD&C Orange No. 1	Orange 1
FD&C Orange No. 2	Orange SS
FD&C Red No. 1	Ponceau 3R
FD&C Red No. 2	Amaranth
FD&C Red No. 3	Erythrosine
FD&C Red No. 4	Ponceau SX
FD&C Red No. 32	Oil Red XO
FD&C Yellow No. 1	Naphthol Yellow S
FD&C Yellow No. 2	Naphthol Yellow S—Potassium Salt
FD&C Yellow No. 3	Yellow AB
FD&C Yellow No. 4	Yellow OB
FD&C Yellow No. 5	Tartrazine
FD&C Yellow No. 6	Sunset Yellow FCF

3) Mixture of two or more dyes mentioned in subparagraphs (1) and (2), of this paragraph, or a mixture of one or more of the dyes with harmless inert materials, such as common salt or sugar.

n) The preparation of a ham for canning shall not result in an increase in weight of more than 8% over the weight of the fresh uncured ham; that is, the weight of the boneless cured ham at the time of canning, plus the weight of the skin, bones, fat, and trimmings removed from the ham, shall not exceed 108% of the weight of the fresh uncured ham.

o) For the purpose of preventing coagulation citric acid or sodium citrate with or without water, may be added to fresh beef blood in an amount not to exceed $\frac{3}{10}$ of 1% of the total mixture. When water is used to make a solution of the citric acid or sodium citrate added to the beef blood, not more than two parts of water to one part of citric acid or sodium citrate shall be used.

p) Harmless bacterial starters of the acidophilus type may be used in the preparation of such kinds of sausage as thuringer, lebanon bologna, cervelat, salami and pork roll in an amount not to exceed ½ of 1 per cent. When used, the harmless bacterial starter shall be included in the list of ingredients in the order of its predominance as required by Parts 16 and 17 of this subchapter.

§ 18.8 Preservatives Permitted in Meat Food Products for Export; Handling; Such Product Not to be Used for Domestic Food Purposes. (*a*) When no substance is used in the preparation or packing of products for export which, either in kind or in proportion, conflicts with the laws of the foreign country to which such

products are to be exported, and the foreign purchaser so directs in writing, products for export to such foreign country may contain preservatives in accordance with such direction. Such products shall be prepared and packed in compartments of the establishment separate and apart from the compartments in which any product is prepared or packed for domestic use or consumption, except as permitted by paragraphs (*b*) and (*i*) of this section and shall be kept separate.

b) The packing of articles which are prepared, as provided for in paragraph (*a*) of this section, with any preservatives not permitted by § 18.7 may be done in the regular packing room, provided no other product be allowed in the packing room during the time of such packing, except as provided in paragraph (*i*) of this section. After the packing is completed, the packing room shall be thoroughly cleansed of the preservative before the packing of other articles therein is resumed. A separate room or compartment constructed of tight partitions or walls shall be set apart for storing the preservatives, trays, and other appliances used in connection with the packing. This room or compartment shall be held under a lock furnished by the Department, the key of which shall not leave the custody of a division employee.

c) The packing of all articles under paragraphs (*a*) and (*b*) of this section shall be conducted under the personal supervision of a division employee.

d) No article prepared or packed for export under paragraph (*a*) or (*b*) shall be sold or offered for sale for domestic use or consumption, but unless exported shall be destroyed for food purposes under the personal supervision of a division employee.

e) The contents of the container of any article prepared or packed for export under paragraph (*a*) or (*b*) of this section shall not be removed, in whole or in part, prior to exportation, except under the supervision of a division employee. If such contents be removed prior to exportation, then the article shall be either repacked in accordance with the provisions of paragraph (*a*) or (*b*) and paragraph (*c*) of this section, or destroyed for food purposes under the personal supervision of a division employee.

f) Permission must be obtained from the chief of division before meats packed in borax are shipped from one official establishment to another or to an unofficial establishment for storage, except such meat prepared for the account of Federal agencies.

g) At all times, the identity of meat to which borax has been added shall be effectively maintained. In no case shall such meat, nor any trimmings or fat derived from such meat, whether unwashed or washed, or otherwise treated, be diverted to domestic use.

h) Salt used for bulking meat previously packed in borax may not again be used in an edible products department other than in connection with the packing of meat in borax. If available, only metal equipment should be used for handling such meat. Particularly effective cleansing will be required if wooden equipment, such as trucks, washing vats, etc., is used. Boxes from which boraxed meat has been removed may be used for repacking meat in borax, but their use as containers for other meat will be dependent upon the effective removal of all traces of borax.

i) The following instructions pertain to export cured pork packed in borax for the account of Federal agencies:

1) The meat may be packed in borax in a room in which there is borax-free meat: *Provided*, Proper care is taken to see that the borax-free meat is not affected by the borax. Under the same condition meat packed in borax may be received, unpacked, defrosted, soaked, washed, smoked, and repacked in a room where there is other meat. However, meat originally packed in borax shall at all times be subject to the restrictions of meat so packed, even though repacked without borax. After packing or repacking, borax meat may be stored in a room with meat not packed in borax: *Provided*, A reasonable degree of separation is maintained between the two classes of product.

§ **18.9 Samples of Products, Water, Dyes, Chemicals, etc., to be Taken for Examination.** Samples of products, water, dyes, chemicals, preservatives, spices, or other articles in any official or exempted establishment shall be taken, without cost to the division, for examination, as often as may be deemed necessary for the efficient conduct of the inspection.

§ **18.10 Prescribed Treatment of Pork and Products Containing Pork to Destroy Trichinæ.** (*a*) All forms of fresh pork, including fresh unsmoked sausage containing pork muscle tissue, and pork such as hams, shoulders, shoulder picnics, bacon, and jowls, which are subjected only to curing or to smoking at temperatures that do not impart to the meat the appearance of being cooked, are classed as products that are customarily well cooked in the home or elsewhere before being served to the consumer. Therefore, the treatment of such products for the destruction of trichinæ is not required.

b) Products containing pork muscle tissue (including hearts, pork stomachs and pork livers) or the pork muscle tissue which forms an ingredient of such products, including, or of the character of, those hereinafter named, are classed as articles which shall be effectively heated, refrigerated, or cured at a federally inspected establishment to destroy any possible live trichinæ: Bologna; frankfurts; viennas; smoked sausage; knoblauch sausage; mortadella; all forms of summer or dried sausage, including mettwurst; cooked loaves; roasted, baked, boiled, or cooked ham, pork shoulder, or pork shoulder picnic; Italian-style ham; Westphalia-style ham; cured meat rolls; capocollo (capicola, capacola); coppa; fresh or cured boneless pork shoulder butts, hams, loins, shoulders, picnics, and similar pork cuts, in casings or other containers in which ready-to-eat delicatessen articles are customarily enclosed; cured boneless pork loin; boneless back bacon (Canadian-style bacon); pork cuts such as hams, shoulders, picnics, and butts which are subjected to smoking at sufficiently high temperatures to impart a partially cooked appearance to the meat (ordinarily, such cuts fall in this class when heated to an internal temperature above 120 °F.).

c) The treatment shall consist of heating, refrigerating, or curing, as follows:

1) *Heating.* All parts of the pork muscle tissue shall be heated to a temperature not lower than 137 °F., and the method used shall be one known to insure such a result. On account of differences in methods of heating and in weights of products undergoing treatment it is impracticable to specify details of procedures for all cases.

Procedures which insure the proper heating of all parts of the product shall be adopted. It is important that each piece of sausage, each ham, and other product treated by heating in water be kept entirely submerged throughout the heating period; and that the largest pieces in a lot, the innermost links of bunched sausage or other massed articles, and pieces placed in the coolest part of a heating cabinet or compartment or vat be included in the temperature tests.

2) *Refrigerating.* At any stage of preparation and after preparatory chilling to a temperature of not above 40 °F. or preparatory freezing, all parts of the muscle tissue of pork or product containing such tissue shall be subjected continuously to a temperature not higher than one of those specified in table 1, the duration of such refrigeration at the specified temperature being dependent on the thickness of the meat or inside dimensions of the container.

TABLE 1.—*Required period of freezing at temperature indicated.*

Temperature	Group 1	Group 2
°F.	*Days*	*Days*
5	20	30
−10	10	20
−20	6	12

Group 1 comprises product in separate pieces not exceeding 6 inches in thickness, or arranged on separate racks with the layers not exceeding 6 inches in depth, or stored in crates or boxes not exceeding 6 inches in depth, or stored as solidly frozen blocks not exceeding 6 inches in thickness.

Group 2 comprises product in pieces, layers, or within containers, the thickness of which exceeds 6 inches but not 27 inches, and product in containers including tierces, barrels, kegs, and cartons having a thickness not exceeding 27 inches.

The product undergoing such refrigeration or the containers thereof shall be so

spaced while in the freezer as will insure a free circulation of air between the pieces of meat, layers, blocks, boxes, barrels, and tierces in order that the temperature of the meat throughout will be promptly reduced to not higher than 5°F., −10° F., or −20°F., as the case may be.

During the period of refrigeration the product or lot thereof shall be kept separate from other products and in the custody of the division. Rooms or compartments equipped for being made secure with division lock or seal shall be provided. The rooms or compartments containing product undergoing freezing shall be equipped with accurate thermometers placed at or above the highest level at which the product undergoing treatment is stored and away from refrigerating coils. After the prescribed freezing has been finished, the product shall be kept under close supervision of an inspector until it is prepared in finished form as one of the articles enumerated in paragraph (*b*) of this section or until it is transferred under division control to another establishment for preparation in finished form.

Pork which has been refrigerated as herein specified may be transferred in sealed railroad cars, sealed motortrucks, sealed wagons, or sealed closed containers to another official establishment at the same or another station for use in the preparation of meat and product of a kind customarily eaten without cooking by the consumer. The sealing of closed containers, such as boxes and slack barrels, shall be effected by cording and affixing thereto division seals, and such containers as tierces and kegs shall be held in division custody by sealing with wax impressed with a division metal brand. Railroad cars, motortrucks, and wagons shall, when necessary, be sealed with division car seals. Properly sealed and marked closed containers may be shipped with other meat in unsealed railroad cars, motortrucks, and wagons. Containers such as boxes, barrels, and tierces shall be plainly and conspicuously marked with a label or stencil furnished by the establishment, as follows: "Pork product ...... degrees F. ...... days' refrigeration," indicating the temperature at which the product was refrigerated and length of time so treated. For each consignment there shall be promptly issued and forwarded to the inspector in charge at destination a report on the form entitled "Notice of Unmarked Meats Shipped in Sealed Cars," appropriately modified to show the character of the containers and that the contents are "Pork product ...... degrees F. ...... days' refrigeration." A duplicate copy should be forwarded to the Washington office of the division. Cured boneless pork loins shall be subjected to prescribed treatment for destruction of trichinæ prior to being shipped from the establishment where cured. Such cured boneless pork loins may then be shipped to other official establishments without sealing but they shall carry the mark of inspection.

3) *Curing*—(i) *Sausage.* Sausage may be stuffed in animal casings, hydrocellulose casings, or cloth bags. During any stage of treating the sausage for the destruction of live trichinæ, except as provided in method 5, these coverings shall not be coated with paraffin or like substance, nor shall any sausage be washed during any prescribed period of drying. In the preparation of sausage, one of the following methods may be used:

Method No. 1. The meat shall be ground or chopped into pieces not exceeding three-fourths of an inch in diameter. A dry-curing mixture containing not less than $3\frac{1}{3}$ pounds of salt to each hundredweight of the unstuffed sausage shall be thoroughly mixed with the ground or chopped meat. After being stuffed, sausage having a diameter not exceeding $3\frac{1}{2}$ inches, measured at the time of stuffing, shall be held in a drying room not less than 20 days at a temperature not lower than 45°F., except that in sausage of the variety known as pepperoni, if in casings not exceeding $1\frac{3}{8}$ inches in diameter measured at the time of stuffing, the period of drying may be reduced to 15 days. In no case, however, shall the sausage be released from the drying room in less than 25 days from the time the curing materials are added, except that sausage of the variety known as pepperoni, if in casings not exceeding the size specified, may be released at the expiration of 20 days from the time the curing materials are added. Sausage in casings exceeding $3\frac{1}{2}$ inches, but not exceeding 4 inches, in diameter at the time of stuffing, shall be held in a drying room not less than 35 days at a temperature not lower than 45°F., and in no case shall the sausage be released from the drying room in less than 40 days from the time the curing materials are added to the meat.

Method No. 2. The meat shall be ground or chopped into pieces not exceeding three-fourths of an inch in diameter. A dry-curing mixture containing not less than $3\frac{1}{3}$ pounds of salt to each hundredweight of the unstuffed sausage shall be thoroughly mixed with the ground or chopped meat. After being stuffed, the sausage having a diameter not exceeding $3\frac{1}{2}$ inches, measured at the time of stuffing, shall be smoked not less than 40 hours at a temperature not lower than 80°F., and finally held in a drying room not less than 10 days at a temperature not lower than 45°F. In no case, however, shall the sausage be released from the drying room in less than 18 days from the time the curing materials are added to the meat. Sausage exceeding $3\frac{1}{2}$ inches, but not exceeding 4 inches, in diameter at the time of stuffing, shall be held in a drying room, following smoking as above indicated, not less than 25 days at a temperature not lower than 45°F., and in no case shall the sausage be released from the drying room in less than 33 days from the time the curing materials are added to the meat.

Method No. 3. The meat shall be ground or chopped into pieces not exceeding three-fourths of an inch in diameter. A dry-curing mixture containing not less than $3\frac{1}{3}$ pounds of salt to each hundredweight of the unstuffed sausage shall be thoroughly mixed with the ground or chopped meat. After admixture with the salt and other curing materials and before stuffing, the ground or chopped meat shall be held at a temperature not lower than 34°F. for not less than 36 hours. After being stuffed the sausage shall be held at a temperature not lower than 34° F. for an additional period of time sufficient to make a total of not less than 144 hours from the time the curing materials are added to the meat, or the sausage shall be held for the time specified in a pickle-curing medium of not less than 50° strength (salometer reading) at a temperature not lower than 44°F. Finally, the sausage having a diameter not exceeding $3\frac{1}{2}$ inches, measured at the time of stuffing, shall be smoked for not less than 12 hours. The temperature of the smokehouse during this period at no time shall be lower than 90° F.; and for 4 consecutive hours of this period the smokehouse shall be maintained at a temperature not lower than 128°F. Sausage exceeding $3\frac{1}{2}$ inches, but not exceeding 4 inches, in diameter at the time of stuffing shall be smoked, following the prescribed curing, for not less than 15 hours. The temperature of the smokehouse during the 15-hour period shall at no time be lower than 90°F., and for 7 consecutive hours of this period the smokehouse shall be maintained at a temperature not lower than 128°F. In regulating the temperature of the smokehouse for the treatment of sausage under this method, the temperature of 128°F. shall be attained gradually during a period of not less than 4 hours.

Method No. 4. The meat shall be ground or chopped into pieces not exceeding one-fourth of an inch in diameter. A dry-curing mixture containing not less than $2\frac{1}{2}$ pounds of salt to each hundredweight of the unstuffed sausage shall be thoroughly mixed with the ground or chopped meat. After admixture with the salt and other curing materials and before stuffing, the ground or chopped sausage shall be held as a compact mass, not more than 6 inches in depth, at a temperature not lower than 36°F. for not less than 10 days. At the termination of the holding period, the sausage shall be stuffed in casings or cloth bags not exceeding $3\frac{1}{2}$ inches in diameter, measured at the time of stuffing. After being stuffed, the sausage shall be held in a drying room at a temperature not lower than 45°F. for the remainder of a 35-day period, measured from the time the curing materials are added to the meat. At any time after stuffing, if a concern deems it desirable, the product may be heated in a water bath for a period not to exceed 3 hours at a temperature not lower than 85°F., or subjected to smoking at a temperature not lower than 80°F., or the product may be both heated and smoked as specified. The time consumed in heating and smoking, however, shall be in addition to the 35-day holding period specified.

Method No. 5. The meat shall be ground or chopped into pieces not exceeding three-fourths of an inch in diameter. A dry-curing mixture containing not less than $3\frac{1}{3}$ pounds of salt to each hundredweight of the unstuffed sausage shall be thoroughly mixed with the ground or chopped meat. After being stuffed the sausage shall be held for not less than 65 days at a temperature not lower than 45°F. The coverings for sausage prepared according to this method may be coated

at any stage of the preparation before or during the holding period with paraffin or other substance approved by the chief of division.

ii) *Capocollo* (*capicola, capacola*). Boneless pork butts for capocollo shall be cured in a dry-curing mixture containing not less than $4\frac{1}{2}$ pounds of salt per hundredweight of meat for a period of not less than 25 days at a temperature not lower than 36°F. If the curing materials are applied to the butts by the process known as churning, a small quantity of pickle may be added. During the curing period the butts may be overhauled according to any of the usual processes of overhauling, including the addition of pickle or dry salt if desired. The butts shall not be subjected during or after curing to any treatment designed to remove salt from the meat, except that superficial washing may be allowed. After being stuffed, the product shall be smoked for a period of not less than 30 hours at a temperature not lower than 80°F., and shall finally be held in a drying room not less than 20 days at a temperature not lower than 45°F.

iii) *Coppa.* Boneless pork butts for coppa shall be cured in a dry-curing mixture containing not less than $4\frac{1}{2}$ pounds of salt per hundredweight of meat for a period of not less than 18 days at a temperature not lower than 36°F. If the curing mixture is applied to the butts by the process known as churning, a small quantity of pickle may be added. During the curing period the butts may be overhauled according to any of the usual processes of overhauling, including the addition of pickle or dry salt if desired. The butts shall not be subjected during or after curing to any treatment designed to remove salt from the meat, except that superficial washing may be allowed. After being stuffed, the product shall be held in a drying room not less than 35 days at a temperature not lower than 45°F.

iv) *Hams.* In the curing of hams either of the following methods may be used:

Method No. 1. The hams shall be cured by a dry-salt curing process not less than 40 days at a temperature not lower than 36°F. The hams shall be laid down in salt, not less than 4 pounds to each hundredweight of hams, the salt being applied in a thorough manner to the lean meat of each ham. When placed in cure the hams may be pumped with pickle if desired. At least once during the curing process the hams shall be overhauled and additional salt applied, if necessary, so that the lean meat of each ham is thoroughly covered. After removal from cure the hams may be soaked in water at a temperature not higher than 70°F. for not more than 15 hours, during which time the water may be changed once; but they shall not be subjected to any other treatment designed to remove salt from the meat, except that superficial washing may be allowed. The hams shall finally be dried or smoked not less than 10 days at a temperature not lower than 95°F.

Method No. 2. The hams shall be cured by a dry-salt curing process at a temperature not lower than 36°F. for a period of not less than 3 days for each pound of weight (green) of the individual hams. The time of cure of each lot of hams placed in cure should be calculated on a basis of the weight of the heaviest ham of the lot. Hams cured by this method, before they are placed in cure, shall be pumped with pickle solution of not less than 100° strength (salometer), about 4 ounces of the solution being injected into the shank and a like quantity along the flank side of the body bone (femur). The hams shall be laid down in salt, not less than 4 pounds of salt to each hundredweight of hams, the salt being applied in a thorough manner to the lean meat of each ham. At least once during the curing process the hams shall be overhauled and additional salt applied, if necessary, so that the lean meat of each ham is thoroughly covered. After removal from the cure the hams may be soaked in water at a temperature not higher than 70°F. for not more than 4 hours, but shall not be subjected to any other treatment designed to remove salt from the meat, except that superficial washing may be allowed. The hams shall then be dried or smoked not less than 48 hours at a temperature not lower than 80°F., and finally shall be held in a drying room not less than 20 days at a temperature not lower than 45°F.

v) *Boneless pork loins and loin ends.* In lieu of heating or refrigerating to destroy trichinæ in boneless loins, the loins shall be cured for a period of not less than 25 days at a temperature not lower than 36°F. by the use of one of the following methods:

Method No. 1. A dry-salt curing mixture containing not less than 5 pounds of salt to each hundredweight of meat.

Method No. 2. A pickle solution of not less than 80° strength (salometer) on the basis of not less than 60 pounds of pickle to each hundredweight of meat.

Method No. 3. A pickle solution added to the approved dry-salt cure provided the pickle solution is not less than 80° strength (salometer).

After removal from cure, the loins may be soaked in water for not more than 1 hour at a temperature not higher than 70°F. or washed under a spray but shall not be subjected, during or after the curing process, to any other treatment designed to remove salt.

Following curing, the loins shall be smoked for not less than 12 hours. The minimum temperature of the smokehouse during this period at no time shall be lower than 100°F., and for 4 consecutive hours of this period the smokehouse shall be maintained at a temperature not lower than 125°F.

Finally, the product shall be held in a drying room for a period of not less than 12 days at a temperature not lower than 45°F.

(*d*) *General Instructions.* When necessary to comply with these instructions, the smokehouses, drying rooms, and other compartments used in the treatment of pork to destroy trichinæ shall be suitably equipped, by the establishment, with accurate automatic recording thermometers. Inspectors in charge are authorized to approve for use in sausage smokehouses, drying rooms, and other compartments, such automatic recording thermometers as are found to give satsifactory service.

To insure the effective administration of the foregoing, inspectors who supervise the handling and treatment of pork to destroy live trichinæ shall:

(1) Recognize the importance of safeguarding the consumer and follow carefully the instructions concerning the treatment of pork to destroy trichinæ.

(2) Check the internal temperatures, with division thermometers, of all products subjected to the heating method.

(3) Test frequently, with division thermometers, the reliability of establishment thermometers (including automatic recording thermometers) and reject for use any found to be inaccurate and unreliable.

(4) Observe division thermometers carefully in order that none be used which have become defective or of questionable accuracy.

(5) Supervise in a methodical manner the handling, in drying, refrigerating, and curing departments, of pork product under treatment for the destruction of live trichinæ, and keep conveniently available, at the official establishment for division use, such records as may be necessary and informative of each lot of product under treatment.

(*e*) The requirements of this section to destroy possible live trichinæ in the products of a kind enumerated in paragraph (*b*) of this section apply to products which are exempted from inspection.

§ 18.11 Canning with Heat Processing and Hermetically Sealed Containers; Cleaning Containers; Closure; Code Marking; Heat Processing; Incubation. (*a*) Containers shall be cleaned thoroughly immediately before filling, and precaution must be taken to avoid soiling the inner surfaces subsequently.

(*b*) Containers of metal, glass, or other material shall be washed in an inverted position with running water at a temperature of at least 180°F. The container-washing equipment shall be provided with a thermometer to register the temperature of the water used for cleaning the containers.

(*c*) Nothing less than perfect closure is acceptable for hermetically sealed containers. Heat processing shall follow promptly after closing.

(*d*) Careful inspection shall be made of the containers by competent establishment employees immediately after closing, and containers which are defectively filled, defectively closed, or those showing inadequate vacuum, shall not be processed until the defect has been corrected. The containers shall again be inspected by establishment employees when they have cooled sufficiently for handling after processing by heating. The contents of defective containers shall be condemned unless correction of the defect is accomplished within 6 hours following the sealing of the containers or completion of the heat processing, as the case may be, except that (1) if the defective condition is discovered during an afternoon run the cans

of product may be held in coolers at a temperature not exceeding 38°F. under conditions that will promptly and effectively chill them until the following day when the defect may be corrected; (2) short vacuum or overstuffed cans of product which have not been handled in accordance with the above may be incubated under division supervision, after which the cans shall be opened and the sound product passed for food; and (3) short vacuum or overstuffed cans of product of a class permitted to be labeled, "Perishable, keep under refrigeration" and which have been kept under adequate refrigeration since processing may be opened and the sound product passed for food.

e) Canned products shall not be passed unless after cooling to atmospheric temperature they show the external characteristics of sound cans; that is, the cans shall not be overfilled; they shall have concave sides, excepting the seam side, and all ends shall be concave; there shall be no bulging; the sides and ends shall conform to the product; and there shall be no slack or loose tin.

f) All canned products shall be plainly and permanently marked on the containers by code or otherwise with the identity of the contents and date of canning. The code used and its meaning shall be on record in the office of the inspector in charge.

g) Canned product must be processed at such temperature and for such period of time as will assure keeping without refrigeration under usual conditions of storage and transportation when heating is relied on for preservation, with the exception of those canned products which are processed without steam-pressure cooking by permission of the chief of division and labeled "Perishable, keep under refrigeration."

h) Lots of canned product shall be identified during their handling preparatory to heat processing by tagging the baskets, cages, or cans with a tag which will change color on going through the heat processing or by other effective means so as to positively preclude failure to heat process after closing.

i) Facilities shall be provided to incubate at least representative samples of the product of fully processed canned product. The incubation shall consist of holding the canned product for at least 10 days at about 98°F.

The extent to which incubation tests shall be required depends on conditions such as the record of the establishment in conducting canning operations, the extent to which the establishment furnishes competent supervision and inspection in connection with the canning operations, the character of the equipment used, and the degree to which such equipment is maintained at maximum efficiency. Such factors shall be considered by the inspector in charge in determining the extent of incubation testing at a particular establishment.

In the event of failure by an establishment to provide suitable facilities for incubation of test samples, the inspector in charge may require holding of the entire lot under such conditions and for such period of time as may, in his discretion, be necessary to establish the stability of the product.

The inspector in charge may permit lots of canned product to be shipped from the establishment prior to completion of sample incubation when he has no reason to suspect unsoundness in the particular lots, and under circumstances which will assure the return of the product to the establishment for reinspection should such action be indicated by the incubation results.

§ 18.12 **Preparation of Dog Food or Similar Uninspected Article at Official Establishments; Edible Products Department; Inedible Products Department; Denaturing.** (*a*) When dog food or similar uninspected article is prepared in an edible product department, there shall be sufficient space allotted and adequate equipment provided so that the preparation of the uninspected article in no way interferes with the handling or preparation of products. Where necessary, separate equipment shall be provided for the uninspected article. To assure the maintenance of sanitary conditions in the edible product departments, the operations incident to the preparation of the uninspected article will be subject to the same sanitary requirements that apply to all operations in edible product departments. The preparation of the uninspected article shall be limited to those hours during which the establishment generally operates under inspectional supervision. That is, there shall be no handling, other than receiving at the establishment, of any

of the meat, meat by-products, or meat food product ingredient of the uninspected article, other than during the regular hours of inspection. The materials used in the preparation of the uninspected article shall not be such as would interfere with the inspection of product or the maintenance of sanitary conditions in the department. The uninspected article may be stored in, and distributed from, edible product department: *Provided*, That adequate facilities are furnished, that there is no interference with the maintenance of sanitary conditions, and that it is properly identified.

b) When dog food or similar uninspected article is prepared in a part of an official establishment other than an edible product department, the area in which the dog food is prepared shall be separated from edible product departments in a manner similar to that required for separation between edible product departments and inedible product departments. Sufficient space must be allotted and adequate equipment provided so that the preparation of the uninspected article does not interfere with the proper functioning of the other operations at the establishment. Nothing in this paragraph shall be construed as permitting any deviation from the requirement that inedible materials, dead animals, and the like, of whatever origin, must be placed in the inedible product rendering equipment, and without undue delay. The preparation of the uninspected product must be such as not to interfere with the maintenance of general sanitary conditions on the premises, and it shall be subject to inspectional supervision similar to that exercised over inedible product departments. There shall be no return of any product to edible product departments. Trucks, barrels, and other equipment shall be cleaned before being returned to edible product departments from inedible product departments. Unoffensive material prepared outside edible product departments may be stored in, and distributed from, edible product departments only if packaged in clean, properly identified, sealed containers.

c) Dog food or other animal food prepared, in whole or in part, from materials derived from cattle, sheep, swine, goats, or horses, shall be distinguished from articles of human food, so as to avoid the distribution of such animal food as human food. To accomplish this, labeling of hermetically sealed, retort processed, conventional retail size containers, as, for example, "dog food" will be considered sufficient. If not in such containers the product must not only be properly identified, but it must be of such character or so treated (denatured or decharacterized) as to be readily distinguishable from an article of human food. Dog food shall not be represented as being a human food.

§ 18.13 Mixtures Containing Products but not Amenable to Meat Inspection Act. Mixtures containing product but not classed as coming under the Meat Inspection Act shall not bear the inspection legend or any abbreviation or representation thereof. When such article is prepared in any part of an official establishment, the sanitation of that part of the establishment shall be supervised by division employees and the preparation of such articles shall not cause any deviation from the requirement that no uninspected product be brought into the establishment.

§ 18.14 Contamination of Product by Flood Water, etc.; Procedure for Handling. (*a*) Any product which has been contaminated by flood water, harbor water, or like polluted water, shall be condemned.

b) After flood water has receded, the establishment shall, under the supervision of a division employee, thoroughly cleanse all walls, ceilings, posts, and floors of the rooms and compartments involved, including the equipment therein. An adequate supply of hot water, under pressure, is essential for effective cleansing of the rooms and equipment. After cleansing, a solution of sodium hypochlorite containing approximately one-half of 1 per cent available chlorine (5,000 parts per million), or other disinfectant approved by the chief of division should be applied to the surface of the rooms. Where the solution has been applied to equipment which will afterwards contact meat, the equipment shall be rinsed with clean water before being used. All metal should be rinsed with clean water to prevent corrosion.

c) Hermetically sealed containers of product which has been submerged or otherwise contaminated as in paragraph (*a*) of this section shall be rehandled promptly under supervision of a division employee as follows:

1) Separate and condemn all product the containers of which show extensive rusting or corrosion, such as might materially weaken the container, as well as any swollen, leaky, or otherwise suspicious container.

2) Remove paper labels and wash the containers in warm soapy water, using a brush where necessary to remove rust or other foreign material, immerse in a solution of sodium hypochlorite containing not less than 100 parts per million of available chlorine or other disinfectant approved specifically for this purpose by the chief of division, and rinse in clean fresh water and dry thoroughly.

3) After handling as in subparagraph (2) of this paragraph, the containers may be relacquered, if necessary, and then relabeled with approved labels applicable to the product therein.

4) The identity of the canned product shall be maintained throughout all stages of the rehandling operations, to insure correct labeling of the containers.

§ 18.15 Glands and Organs for Use in Preparing Pharmaceutical, Organotherapeutic, or Technical Products. (*a*) Glands and organs which are not used as food products, such as cotyledons, ovaries, prostate glands, tonsils, spinal cords, and detached lymphatic, pineal, pituitary, parathyroid, suprarenal, pancreatic, and thyroid glands, may be shipped interstate either by establishments operating under inspection or by those which do not operate under inspection: *Provided*, That the containers shall be plainly marked "For pharmaceutical purposes," "For organotherapeutic purposes," or "For technical purposes," without any reference to inspection.

Organs in this category may be brought into and stored in edible product departments of inspected establishments or shipped with edible product if packaged in suitable containers which will in no way interfere with the maintenance of sanitary conditions or constitute an interference with inspection.

b) Glands or organs which are regarded as food products, such as livers, testicles, and thymus, may be shipped interstate or brought into official establishments for pharmaceutical, organotherapeutic, or technical purposes, only if U. S. inspected and passed and so identified.

§ 18.16 Tagging Chemicals, Preservatives, Cereals, Spices, etc., "U. S. Retained." When any chemical, preservative, cereal, spice, or other substance is presented for use in an official establishment, it shall be examined by a division employee, and if found to be unfit or otherwise unacceptable for the use intended, or if final decision regarding acceptance is deferred pending laboratory or other examination, the employee shall attach a "U. S. retained" tag to the substance or container thereof. The substance so tagged shall be kept separate from other substances as the inspector in charge may require, shall not be used until the tag is removed, and such removal shall be only by a division employee after a finding that the substance can be accepted, or, in the case of an unacceptable substance, when it is removed from the establishment.

§ 18.17 Product for Educational Uses, Laboratory Examination, and Other Purposes. When authorized by the chief of division, product of special type or kind may be shipped or transported from official establishments for educational uses, laboratory examination, and other purposes.

PART 19—MARKET INSPECTION

Sec.

PART 20—REPORTS

Sec.

PART 21—APPEALS

§21.1 **Appeals From Meat Inspection Actions.**

PART 22—COOPERATION WITH LOCAL AUTHORITIES

PART 23—BRIBERY, COUNTERFEITING, ETC.

PART 24—EXPORT STAMPS AND CERTIFICATES

PART 25—TRANSPORTATION

25.15 Certificates to be filed and retained by carriers for one year.
25.16 Diverting of shipments, breaking of seals and reloading by carrier in emergency; reporting to chief of division.
25.17 Provisions in this part do not apply to specimens for laboratory examination, etc., or to inedible articles not having physical characteristics of edible products.

PART 26—FEDERAL FOOD, DRUG, AND COSMETIC ACT

§ 26.1 Federal Food, Drug, and Cosmetic Act; Foods Containing Product Derived From Cattle, Sheep, Swine, Goats, or Horses, Compliance With.

PART 27—IMPORTED PRODUCTS

Sec.
27.1 Application.
27.2 Importation of product prohibited if foreign meat inspection not equivalent of that in the United States.
27.3 When product, etc., probihited entry; preservatives, misbranding, etc.
27.4 Importation of foreign inedible fats.
27.5 No product to be imported without compliance with regulations.
27.6 Imported product; foreign certificates required.
27.7 Importer to make application for inspection; information required.
27.8 Import meat or meat food products; division inspection; arrival, time and place; movement from port of entry.
27.9 Import product; movement prior to inspection; sealing; handling; bond; facilities and assistance.
27.10 Import product; equipment of conveyances used in handling to be maintained in sanitary condition.
27.11 Burlap wrapping for foreign meat.
27.12 Product imported; samples; inspection of whole consignment; condemnations; exception; marking.
27.13 Receipts to importers for import meat samples.
27.14 Foreign canned and packaged meat and meat food product, bearing trade labels; sampling and inspection.
27.15 Foreign product offered for importation; reporting of findings to customs; handling and marking of articles refused entry; marking carcasses and parts.
27.16 Marking and labeling of product U. S. inspected and passed for importation; application of inspection legend.
27.17 Outside containers of foreign products; marking and labeling.
27.18 Small importations for consignee's personal use; requirements.
27.19 Returned United States inspected and marked products; not importations.
27.20 Imported product to be handled and transported as domestic; entry into official establishments; transportation.

PART 28—DEFINITIONS AND STANDARDS OF IDENTITY

§ 28.1 Oleomargarine; Identity; Label Statement of Optional Ingredients.

PART 29—INSPECTION AND HANDLING OF HORSE MEAT AND PRODUCTS THEREOF

Sec.
29.1 Establishments required to have inspection.
29.2 Slaughter of horses and preparation of meat thereof; separate establishments.
29.3 Affections requiring condemnation on ante-mortem or post-mortem inspection; glanders and dourine suspects.
29.4 Horse carcasses, meat and meat food products thereof; marking and labeling.

FEDERAL SECURITY AGENCY

Food and Drug Administration

FEDERAL FOOD, DRUG, AND COSMETIC ACT AND GENERAL REGULATIONS FOR ITS ENFORCEMENT

PUBLIC—NO. 717—SEVENTY-FIFTH CONGRESS, CHAPTER 675, THIRD SESSION, S. 5

AN ACT

To prohibit the movement in interstate commerce of adulterated and misbranded food, drugs, devices, and cosmetics, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

CHAPTER I—SHORT TITLE

SECTION 1. This Act may be cited as the Federal Food, Drug, and Cosmetic Act.

CHAPTER II—DEFINITIONS

CHAPTER III—PROHIBITED ACTS AND PENALTIES

PROHIBITED ACTS

SEC. 301. The following acts and the causing thereof are hereby prohibited:

a) The introduction or delivery for introduction into interstate commerce of any food, drug, device, or cosmetic that is adulterated or misbranded.

b) The adulteration or misbranding of any food, drug, device, or cosmetic in interstate commerce.

c) The receipt in interstate commerce of any food, drug, device, or cosmetic that is adulterated or misbranded, and the delivery or proffered delivery thereof for pay or otherwise.

d) The introduction or delivery for introduction into interstate commerce of any article in violation of section 404 or 505.

e) The refusal to permit access to or copying of any record as required by section 703.

f) The refusal to permit entry or inspection as authorized by section 704.

g) The manufacture within any Territory of any food, drug, device, or cosmetic that is adulterated or misbranded.

h) The giving of a guaranty or undertaking referred to in section 303 (*c*) (2), which guaranty or undertaking is false, except by a person who relied upon a guaranty or undertaking to the same effect signed by, and containing the name and address of, the person residing in the United States from whom he received in good faith the food, drug, device, or cosmetic; or the giving of a guaranty or undertaking referred to in section 303 (*c*) (3), which guaranty or undertaking is false.

Regulation. [§ 1.4] In case of the giving of a guaranty or undertaking referred to in section 303 (*c*) (2) or (3) of the Act, each person signing such guaranty or undertaking shall be considered to have given it.

[SEC. 301. The following acts and the causing thereof are hereby prohibited.

i) Forging, counterfeiting, simulating, or falsely representing, or without proper authority using any mark, stamp, tag, label, or other identification device authorized or required by regulations promulgated under the provisions of section 404, 406 (*b*), 504, 506, 507, or 604.

j) The using by any person to his own advantage, or revealing, other than to the Administrator or officers or employees of the Agency, or to the courts when relevant in any judicial proceeding under this Act, any information acquired under authority of section 404, 505, 506, 507, or 704 concerning any method or process which as a trade secret is entitled to protection.

k) The alteration, mutilation, destruction, obliteration, or removal of the whole or any part of the labeling of, or the doing of any other act with respect to, a food, drug, device, or cosmetic, if such act is done while such article is held for sale (whether or not the first sale) after shipment in interstate commerce and results in such article being adulterated or misbranded.

l) The using, on the labeling of any drug or in any advertising relating to such drug, of any representation or suggestion that an application with respect to such drug is effective under section 505, or that such drug complies with the provisions of such section.

INJUNCTION PROCEEDINGS

SEC. 302. (*a*) The district courts of the United States and the United States courts of the Territories shall have jurisdiction, for cause shown, and subject to the provisions of section 17 (relating to notice to opposite party) of the Act entitled "An Act to supplement existing laws against unlawful restraints and monopolies, and for other purposes," approved October 15, 1914, as amended (U. S. C., 1934 ed., title 28, sec. 381), to restrain violations of section 301, except paragraphs (*e*), (*f*), (*h*), (*i*), and (*j*).

b) In case of violation of an injunction or restraining order issued under this section, which also constitutes a violation of this Act, trial shall be by the court, or, upon demand of the accused, by a jury. Such trial shall be conducted in accordance with the practice and procedure applicable in the case of proceedings subject to the provisions of section 22 of such Act of October 15, 1914, as amended (U. S. C., 1934 ed., title 28, sec. 387).

PENALTIES

SEC. 303. (*a*) Any person who violates any of the provisions of section 301 shall be guilty of a misdemeanor and shall on conviction thereof be subject to imprisonment for not more than one year, or a fine of not more than $1,000, or both such imprisonment and fine; but if the violation is committed after a conviction of such person under this section has become final such person shall be subject to imprisonment for not more than three years, or a fine of not more than $10,000, or both such imprisonment and fine.

b) Notwithstanding the provisions of subsection (*a*) of this section, in case of a violation of any of the provisions of section 301, with intent to defraud or mislead, the penalty shall be imprisonment for not more than three years, or a fine of not more than $10,000, or both such imprisonment and fine.

c) No person shall be subject to the penalties of subsection (*a*) of this section, (1) for having received in interstate commerce any article and delivered it or proffered delivery of it, if such delivery or proffer was made in good faith, unless he refuses to furnish on request of an officer or employee duly designated by the Administrator the name and address of the person from whom he purchased or received such article and copies of all documents, if any there be, pertaining to the delivery of the article to him; or (2) for having violated section 301 (*a*) or (*d*), if he establishes a guaranty or undertaking signed by, and containing the name and address of, the person residing in the United States from whom he received in good faith the article, to the effect, in case of an alleged violation of section 301 (*a*), that such article is not adulterated or misbranded, within the meaning of this Act, designating this Act, or to the effect, in case of an alleged violation of section 301

(*d*), that such article is not an article which may not, under the provisions of section 404 or 505, be introduced into interstate commerce; or (3) for having violated section 301 (*a*), where the violation exists because the article is adulterated by reason of containing a coal-tar color not from a batch certified in accordance with regulations promulgated by the Administrator under this Act, if such person establishes a guaranty or undertaking signed by, and containing the name and address of, the manufacturer of the coal-tar color, to the effect that such color was from a batch certified in accordance with the applicable regulations promulgated by the Administrator under this Act.

Regulation. [§ 1.5] (*a*) A guaranty or undertaking referred to in section 303 (*c*) (2) of the Act may be:

1) limited to a specific shipment or other delivery of an article, in which case it may be a part of or attached to the invoice or bill of sale covering such shipment or delivery, or

2) general and continuing, in which case, in its application to any shipment or other delivery of an article, it shall be considered to have been given at the date such article was shipped or delivered by the person who gives the guaranty or undertaking.

b) The following are suggested forms of guaranty or undertaking under section 303 (*c*) (2) of the Act:

1) Limited Form for use on invoice or bill of sale.

(Name of person giving the guaranty or undertaking) hereby guarantees that no article listed herein is adulterated or misbranded within the meaning of the Federal Food, Drug, and Cosmetic Act, or is an article which may not, under the provisions of section 404 or 505 of the Act, be introduced into interstate commerce.

(Signature and post-office address of person giving the guaranty or undertaking.)

2) General and Continuing Form.

The article comprising each shipment or other delivery hereafter made by (name of person giving the guaranty or undertaking) to, or on the order of (name and post-office address of person to whom the guaranty or undertaking is given) is hereby guaranteed, as of the date of such shipment or delivery, to be, on such date, not adulterated or misbranded within the meaning of the Federal Food, Drug, and Cosmetic Act, and not an article which may not, under the provisions of section 404 or 505 of the Act, be introduced into interstate commerce.

(Signature and post-office address of person giving the guaranty or undertaking.)

c) The application of a guaranty or undertaking referred to in section 303 (*c*) (2) of the Act to any shipment or other delivery of an article shall expire when such article, after shipment or delivery by the person who gave such guaranty or undertaking, becomes adulterated or misbranded within the meaning of the Act, or becomes an article which may not, under the provisions of section 404 or 505 of the Act, be introduced into interstate commerce.

d) A guaranty or undertaking referred to in section 303 (*c*) (3) of the Act shall state that the shipment or other delivery of coal-tar color covered thereby was manufactured by a signer thereof. It may be a part of or attached to the invoice or bill of sale covering such color. If such shipment or delivery is from a foreign manufacturer, such guaranty or undertaking shall be signed by such manufacturer and by an agent of such manufacturer who resides in the United States.

e) The following are suggested forms of guaranty or undertaking under section 303 (*c*) (3) of the Act:

1) For domestic manufacturers.

(Name of manufacturer) hereby guarantees that all coal-tar colors listed herein were manufactured by him, and are from batches certified in accordance with the applicable regulations promulgated under the Federal Food, Drug, and Cosmetic Act.

(Signature and post-office address of manufacturer.)

2) For foreign manufacturers.

(Name of manufacturer and agent) hereby severally guarantee that all coal-tar colors listed herein were manufactured by (name of manufacturer), and are from batches certified in accordance with the applicable regulations promulgated under the Federal Food, Drug, and Cosmetic Act.

(Signature and post-office address of manufacturer.)

(Signature and post-office address of agent.)

f) For the purpose of a guaranty or undertaking under section 303 (*c*) (3) of the Act the manufacturer of a shipment or other delivery of a coal-tar color is the person who packaged such color.

g) A guaranty or undertaking, if signed by two or more persons, shall state that such persons severally guarantee the article to which it applies.

h) No representation or suggestion that an article is guaranteed under the Act shall be made in labeling.

SEIZURE

SEC. 304. (*a*) Any article of food, drug, device, or cosmetic that is adulterated or misbranded when introduced into or while in interstate commerce or while held for sale (whether or not the first sale) after shipment in interstate commerce, or which may not, under the provisions of section 404 or 505, be introduced into interstate commerce, shall be liable to be proceeded against while in interstate commerce, or at anytime thereafter, on libel of information and condemned in any district court of the United States within the jurisdiction of which the article is found: *Provided, however*, That no libel for condemnation shall be instituted under this Act, for any alleged misbranding if there is pending in any court a libel for condemnation proceeding under this Act based upon the same alleged misbranding, and not more than one such proceeding shall be instituted if no such proceeding is so pending, except that such limitations shall not apply (1) when such misbranding has been the basis of a prior judgment in favor of the United States, in a criminal, injunction, or libel for condemnation proceeding under this Act, or (2) when the Administrator has probable cause to believe from facts found, without hearing, by him or any officer or employee of the Agency that the misbranded article is dangerous to health, or that the labeling of the misbranded article is fraudulent, or would be in a material respect misleading to the injury or damage of the purchaser or consumer. In any case where the number of libel for condemnation proceedings is limited as above provided the proceeding pending or instituted shall, on application of the claimant, seasonably made, be removed for trial to any district agreed upon by stipulation between the parties, or, in case of failure to so stipulate within a reasonable time, the claimant may apply to the court of the district in which the seizure has been made, and such court (after giving the United States attorney for such district reasonable notice and opportunity to be heard) shall by order, unless good cause to the contrary is shown, specify a district of reasonable proximity to the claimant's principal place of business to which the case shall be removed for trial.

b) The article shall be liable to seizure by process pursuant to the libel, and the procedure in cases under this section shall conform, as nearly as may be, to the procedure in admiralty; except that on demand of either party any issue of fact joined in any such case shall be tried by jury. When libel for condemnation proceedings under this section, involving the same claimant and the same issues of adulteration or misbranding, are pending in two or more jurisdictions, such pending proceedings, upon application of the claimant seasonably made to the court of one such jurisdiction, shall be consolidated for trial by order of such court, and tried in (1) any district selected by the claimant where one of such proceedings is pending; or (2) a district agreed upon by stipulation between the parties. If no order for consolidation is so made within a reasonable time, the claimant may apply to the court of one such jurisdiction, and such court (after giving the United States attorney for such district reasonable notice and opportunity to be heard) shall by order, unless good cause to the contrary is shown, specify a district of reasonable proximity to the claimant's principal place of business, in which all such

pending proceedings shall be consolidated for trial and tried. Such order of consolidation shall not apply so as to require the removal of any case the date for trial of which has been fixed. The court granting such order shall give prompt notification thereof to the other courts having jurisdiction of the cases covered thereby.

(*c*) The court at any time after seizure up to a reasonable time before trial shall by order allow any party to a condemnation proceeding, his attorney or agent, to obtain a representative sample of the article seized, and as regards fresh fruits or fresh vegetables, a true copy of the analysis on which the proceeding is based and the identifying marks or numbers, if any, of the packages from which the samples analyzed were obtained.

(*d*) Any food, drug, device, or cosmetic condemned under this section shall, after entry of the decree, be disposed of by destruction or sale as the court may, in accordance with the provisions of this section, direct and the proceeds thereof, if sold, less the legal costs and charges, shall be paid into the Treasury of the United States; but such article shall not be sold under such decree contrary to the provisions of this Act or the laws of the jurisdiction in which sold: *Provided*, That after entry of the decree and upon the payment of the costs of such proceedings and the execution of a good and sufficient bond conditioned that such article shall not be sold or disposed of contrary to the provisions of this Act or the laws of any State or Territory in which sold, the court may by order direct that such article be delivered to the owner thereof to be destroyed or brought into compliance with the provisions of this Act under the supervision of an officer or employee duly designated by the Administrator, and the expenses of such supervision shall be paid by the person obtaining release of the article under bond. Any article condemned by reason of its being an article which may not, under section 404 or 505, be introduced into interstate commerce, shall be disposed of by destruction.

(*e*) When a decree of condemnation is entered against the article, court costs and fees, and storage and other proper expenses, shall be awarded against the person, if any, intervening as claimant of the article.

(*f*) In the case of removal for trial of any case as provided by subsection (*a*) or (*b*)—

(1) The clerk of the court from which removal is made shall promptly transmit to the court in which the case is to be tried all records in the case necessary in order that such court may exercise jurisdiction.

(2) The court to which such case was removed shall have the powers and be subject to the duties, for purposes of such case, which the court from which removal was made would have had, or to which such court would have been subject, if such case had not been removed.

HEARING BEFORE REPORT OF CRIMINAL VIOLATION

SEC. 305. Before any violation of this Act is reported by the Administrator to any United States attorney for institution of a criminal proceeding, the person against whom such proceeding is contemplated shall be given appropriate notice and an opportunity to present his views, either orally or in writing, with regard to such contemplated proceeding.

Regulation. [§ 1.6] (*a*) Presentation of views under section 305 of the Act shall be private and informal. The views presented shall be confined to matters relevant to the contemplated proceeding. Such views may be presented by letter or in person by the person to whom the notice was given, or by his representative. In case such person holds a guaranty or undertaking referred to in section 303 (*c*) (2) or (3) of the Act applicable to the article on which such notice was based, such guaranty or undertaking, or a verified copy thereof, shall be made a part of such presentation of views.

(*b*) Upon request, seasonably made, by the person to whom a notice appointing a time and place for the presentation of views under section 305 of the Act has been given, or by his representative, such time or place, or both such time and place, may be changed if the request states reasonable grounds therefor. Such

request shall be addressed to the office of the Food and Drug Administration which issued the notice.

REPORT OF MINOR VIOLATIONS

SEC. 306. Nothing in this Act shall be construed as requiring the Administrator to report for prosecution, or for the institution of libel or injunction proceedings, minor violations of this Act whenever he believes that the public interest will be adequately served by a suitable written notice or warning.

PROCEEDINGS IN NAME OF UNITED STATES; PROVISION AS TO SUBPENAS

SEC. 307. All such proceedings for the enforcement, or to restrain violations, of this Act shall be by and in the name of the United States. Notwithstanding the provisions of section 876 of the Revised Statutes, subpenas for witnesses who are required to attend a court of the United States, in any district, may run into any other district in any such proceeding.

CHAPTER IV—FOOD

DEFINITIONS AND STANDARDS FOR FOOD

SEC. 401. Whenever in the judgment of the Administrator such action will promote honesty and fair dealing in the interest of consumers, he shall promulgate regulations fixing and establishing for any food, under its common or usual name so far as practicable, a reasonable definition and standard of identity, a reasonable standard of quality, and/or reasonable standards of fill of container: *Provided*, That no definition and standard of identity and no standard of quality shall be established for fresh or dried fruits, fresh or dried vegetables, or butter, except that definitions and standards of identity may be established for avocadoes, cantaloupes, citrus fruits, and melons. In prescribing any standard of fill of container, the Administrator shall give due consideration to the natural shrinkage in storage and in transit of fresh natural food and to need for the necessary packing and protective material. In the prescribing of any standard of quality for any canned fruit or canned vegetable, consideration shall be given and due allowance made for the differing characteristics of the several varieties of such fruit or vegetable. In prescribing a definition and standard of identity for any food or class of food in which optional ingredients are permitted, the Administrator shall, for the purpose of promoting honesty and fair dealing in the interest of consumers, designate the optional ingredients which shall be named on the label. Any definition and standard of identity prescribed by the Administrator for avocadoes, cantaloupes, citrus fruits, or melons shall relate only to maturity and to the effects of freezing.

ADULTERATED FOOD

SEC. 402. A food shall be deemed to be adulterated—

a) (1) If it bears or contains any poisonous or deleterious substance which may render it injurious to health; but in case the substance is not an added substance such food shall not be considered adulterated under this clause if the quantity of such substance in such food does not ordinarily render it injurious to health; or (2) if it bears or contains any added poisonous or added deleterious substance which is unsafe within the meaning of section 406; or (3) if it consists in whole or in part of any filthy, putrid, or decomposed substance, or if it is otherwise unfit for food; or (4) if it has been prepared, packed, or held under insanitary conditions whereby it may have become contaminated with filth, or whereby it may have been rendered injurious to health; or (5) if it is, in whole or in part, the product of a diseased animal or of an animal which has died otherwise than by slaughter; or (6) if its container is composed, in whole or in part, of any poisonous or deleterious substance which may render the contents injurious to health.

b) (1) If any valuable constituent has been in whole or in part omitted or ab-

stracted therefrom; or (2) if any substance has been substituted wholly or in part therefor; or (3) if damage or inferiority has been concealed in any manner; or (4) if any substance has been added thereto or mixed or packed therewith so as to increase its bulk or weight, or reduce its quality or strength, or make it appear better or of greater value than it is.

c) If it bears or contains a coal-tar color other than one from a batch that has been certified in accordance with regulations as provided by section 406: *Provided*, That this paragraph shall not apply to citrus fruit bearing or containing a coal-tar color if application for listing of such color has been made under this Act and such application has not been acted on by the Administrator, if such color was commonly used prior to the enactment of this Act for the purpose of coloring citrus fruit.

d) If it is confectionery, and it bears or contains any alcohol or nonnutritive article or substance except harmless coloring, harmless flavoring, harmless resinous glaze not in excess of four-tenths of 1 per centum, natural gum, and pectin: *Provided*, That this paragraph shall not apply to any confectionery by reason of its containing less than one-half of 1 per centum by volume of alcohol derived solely from the use of flavoring extracts, or to any chewing gum by reason of its containing harmless nonnutritive masticatory substances.

MISBRANDED FOOD

SEC. 403. A food shall be deemed to be misbranded—

a) If its labeling is false or misleading in any particular.

Regulation. [§ 1.7] (*a*) Among representations in the labeling of a food which render such food misbranded is a false or misleading representation with respect to another food or a drug, device, or cosmetic.

b) The labeling of a food which contains two or more ingredients may be misleading by reason (among other reasons) of the designation of such food in such labeling by a name which includes or suggests the name of one or more but not all such ingredients, even though the names of all such ingredients are stated elsewhere in the labeling.

b) If it is offered for sale under the name of another food.

c) If it is an imitation of another food, unless its label bears, in type of uniform size and prominence, the word "imitation" and, immediately thereafter, the name of the food imitated.

d) If its container is so made, formed, or filled as to be misleading.

e) If in package form unless it bears a label containing (1) the name and place of business of the manufacturer, packer, or distributor; and (2) an accurate statement of the quantity of the contents in terms of weight, measure, or numerical count: *Provided*, That under clause (2) of this paragraph reasonable variations shall be permitted, and exemptions as to small packages shall be established, by regulations prescribed by the Administrator.

Regulation. [§ 1.8] (*a*) Where a food is not manufactured by the person whose name appears on the label, the name shall be qualified by a phrase which reveals the connection such person has with such food, such as "Manufactured for and Packed by ....," "Distributed by ....," or other similar phrase which expresses the facts.

b) The statement of the place of business shall include the street address, if any, of such place, unless such street address is shown in a current city directory or telephone directory.

c) If a person manufactures, packs, or distributes a food at a place other than his principal place of business, the label may state the principal place of business in lieu of the actual place where each package of such food was manufactured or packed or is to be distributed, if such statement is not misleading in any particular.

d) The requirement that the label shall contain the name and place of business of the manufacturer, packer, or distributor shall not be considered to relieve any food from the requirement that its label shall not be misleading in any particular.

e) (1) The statement of the quantity of the contents shall reveal the quantity of food in the package, exclusive of wrappers and other material packed with such food.

2) The statement shall be expressed in the terms of weight, measure, numerical count, or a combination of numerical count and weight or measure, which are generally used by consumers to express quantity of such food and which give accurate information as to the quantity thereof. But if no general consumer usage in expressing accurate information as to the quantity of such food exists, the statement shall be in terms of liquid measure if the food is liquid, or in terms of weight if the food is solid, semi-solid, viscous, or a mixture of solid and liquid; except that such statement may be in terms of dry measure if the food is a fresh fruit, fresh vegetable, or other dry commodity.

f) (1) A statement of weight shall be in terms of the avoirdupois pound and ounce. A statement of liquid measure shall be in terms of the United States gallon of 231 cubic inches and quart, pint, and fluid ounce subdivisions thereof, and, except in case of frozen food which is so consumed, shall express the volume at 68° Fahrenheit (20° Centigrade). A statement of dry measure shall be in terms of the United States bushel of 2150.42 cubic inches and peck, dry quart, and dry pint subdivisions thereof; or in terms of the United States standard barrel and its subdivisions of third, half, and three-quarters barrel. However, in the case of an export shipment, the statement may be in terms of a system of weight or measure in common use in the country to which such shipment is exported.

2) A statement of weight or measure in the terms specified in subparagraph (1) of this paragraph may be supplemented by a statement in terms of the metric system of weight or measure.

3) Unless an unqualified statement of numerical count gives accurate information as to the quantity of food in the package, it shall be supplemented by such statement of weight, measure, or size of the individual units of the food as will give such information.

g) Statements shall contain only such fractions as are generally used in expressing the quantity of the food. A common fraction shall be reduced to its lowest terms; a decimal fraction shall not be carried out to more than two places.

h) (1) If the quantity of food in the package equals or exceeds the smallest unit of weight or measure which is specified in paragraph (*f*) of this section, and which is applicable to such food under the provisions of paragraph (*e*) (2) of this section, the statement shall express the number of the largest of such units contained in the package (for example, the statement on the label of a package which contains one quart of food shall be "1 quart," and not "2 pints" or "32 fluid ounces"), unless the statement is made in accordance with the provisions of subparagraph (2) of this paragraph. Where such number is a whole number and a fraction, there may be substituted for the fraction its equivalent in smaller units, if any smaller is specified in such paragraph (*f*) (for examples, $1\frac{3}{4}$ quarts may be expressed as "1 quart $1\frac{1}{2}$ pints" or "1 quart 1 pint 8 fluid ounces;" $1\frac{1}{4}$ pounds may be expressed as "1 pound 4 ounces"). The stated number of any unit which is smaller than the largest unit (specified in such paragraph (*f*) contained in the package shall not equal or exceed the number of such smaller units in the next larger unit so specified (for examples, instead of "1 quart 16 fluid ounces" the statement shall be "$1\frac{1}{2}$ quarts" or "1 quart 1 pint"; instead of "24 ounces" the statement shall be "$1\frac{1}{2}$ pounds" or "1 pound 8 ounces").

2) In the case of a food with respect to which there exists an established custom of stating the quantity of the contents as a fraction of a unit, which unit is larger than the quantity contained in the package, or as units smaller than the largest unit contained therein, the statement may be made in accordance with such custom if it is informative to consumers.

i) The statement shall express the minimum quantity or the average quantity, of the contents of the packages. If the statement is not so qualified as to show definitely that the quantity expressed is the minimum quantity, the statement shall be considered to express the average quantity.

j) Where the statement expresses the minimum quantity, no variation below the stated minimum shall be permitted except variations below the stated weight or measure caused by ordinary and customary exposure, after the food is introduced into interstate commerce, to conditions which normally occur in good distribution practice and which unavoidably result in decreased weight or measure. Variations above the stated minimum shall not be unreasonably large.

k) Where the statement does not express the minimum quantity:

1) variations from the stated weight or measure shall be permitted when caused by ordinary and customary exposure, after the food is introduced into interstate commerce, to conditions which normally occur in good distribution practice and which unavoidably result in change of weight or measure;

2) variations from the stated weight, measure, or numerical count shall be permitted when caused by unavoidable deviations in weighing, measuring, or counting individual packages which occur in good packing practice.

But under subparagraph (2) of this paragraph variations shall not be permitted to such extent that the average of the quantities in the packages comprising a shipment or other delivery of the food is below the quantity stated, and no unreasonable shortage in any package shall be permitted, even though overages in other packages in the same shipment or delivery compensate for such shortage.

l) The extent of variations from the stated quantity of the contents permissible under paragraphs (*j*) and (*k*) of this section in the case of each shipment or other delivery shall be determined by the facts in such case.

m) A food shall be exempt from compliance with the requirements of clause (2) of section 403 (*e*) of the Act if:

1) The quantity of the contents, as expressed in terms applicable to such food under the provisions of paragraph (*e*) (2) of this section, is less than one-half ounce avoirdupois, or less than one-half fluid ounce, or (in case the units of the food can be easily counted without opening the package) less than six units; or

2) The statement of the quantity of the contents of the package, together with all other words, statements, and information required by or under authority of the Act to appear on the label, cannot, because of insufficient label space, be so placed on the label as to comply with the requirements of section 403 (*f*) of the Act and regulations promulgated thereunder.

f) If any word, statement, or other information required by or under authority of this Act to appear on the label or labeling is not prominently placed thereon with such conspicuousness (as compared with other words, statements, designs, or devices, in the labeling) and in such terms as to render it likely to be read and understood by the ordinary individual under customary conditions of purchase and use.

Regulation. [§ 1.9] (*a*) A word, statement, or other information required by or under authority of the Act to appear on the label may lack that prominence and conspicuousness required by section 403 (*f*) of the Act by reason (among other reasons) of:

1) The failure of such word, statement, or information to appear on the part or panel of the label which is presented or displayed under customary conditions of purchase;

2) The failure of such word, statement, or information to appear on two or more parts or panels of the label, each of which has sufficient space therefor, and each of which is so designed as to render it likely to be, under customary conditions of purchase, the part or panel displayed;

3) The failure of the label to extend over the area of the container or package available for such extension, so as to provide sufficient label space for the prominent placing of such word, statement, or information;

4) Insufficiency of label space (for the prominent placing of such word, statement, or information) resulting from the use of label space for any word, statement, design, or device which is not required by or under authority of the Act to appear on the label;

5) Insufficiency of label space (for the prominent placing of such word, statement, or information) resulting from the use of label space to give materially greater conspicuousness to any other word, statement, or information, or to any design or device; or

6) Smallness or style of type in which such word, statement, or information appears, insufficient background contrast, obscuring designs or vignettes, or crowding with other written, printed, or graphic matter.

b) No exemption depending on insufficiency of label space, as prescribed in regulations promulgated under section 403 (*e*) or (*i*) of the Act, shall apply if such insufficiency is caused by:

1) The use of label space for any word, statement, design, or device which is not required by or under authority of the Act to appear on the label;

2) The use of label space, to give greater conspicuousness to any word, statement, or other information than is required by section 403 (*f*) of the Act; or

3) The use of label space for any representation in a foreign language.

c) (1) All words, statements, and other information required by or under authority of the Act to appear on the label or labeling shall appear thereon in the English language.

2) If the label contains any representation in a foreign language, all words, statements, and other information required by or under authority of the Act to appear on the label shall appear thereon in the foreign language.

3) If the labeling contains any representation in a foreign language, all words, statements, and other information required by or under authority of the Act to appear on the label or labeling shall appear on the labeling in the foreign language.

g) If it purports to be or is represented as a food for which a definition and standard of identity has been prescribed by regulations as provided by section 401, unless (1) it conforms to such definition and standard, and (2) its label bears the name of the food specified in the definition and standard, and, insofar as may be required by such regulations, the common names of optional ingredients (other than spices, flavoring, and coloring) present in such food.

Regulation. [§ 1.14] In the following conditions, among others, a food does not conform to the definition and standard of identity therefor:

a) If it contains an ingredient for which no provision is made in such definition and standard;

b) If it fails to contain any one or more ingredients required by such definition and standard;

c) If the quantity of any ingredient or component fails to conform to the limitation, if any, prescribed therefor by such definition and standard.

h) If it purports to be or is represened as—

1) a food for which a standard of quality has been prescribed by regulations as provided by section 401, and its quality falls below such standard, unless its label bears, in such manner and form as such regulations specify, a statement that it falls below such standard; or

2) a food for which a standard or standards of fill of container have been prescribed by regulations as provided by section 401, and it falls below the standard of fill of container applicable thereto, unless its label bears, in such manner and form as such regulations specify, a statement that it falls below such standard.

i) If it is not subject to the provisions of paragraph (*g*) of this section unless its label bears (1) the common or usual name of the food, if any there be, and (2) in case it is fabricated from two or more ingredients, the common or usual name of each such ingredient; except that spices, flavorings, and colorings, other than those sold as such, may be designated as spices, flavorings, and colorings without naming each: *Provided,* That to the extent that compliance with the requirements of clause (2) of this paragraph is impracticable, or results in deception or unfair competition, exemptions shall be established by regulations promulgated by the Administrator.

Regulation. [§ 1.10] (*a*) The name of an ingredient (except a spice, flavoring, or coloring which is an ingredient of a food other than one sold as a spice, flavoring, or coloring), required by section 403 (*i*) (2) of the Act to be borne on the label of a food, shall be a specific name and not a collective name. But if an

ingredient (which itself contains two or more ingredients) conforms to a definition and standard of identity prescribed by regulations under section 401 of the Act, such ingredient may be designated on the label of such food by the name specified in the definition and standard, supplemented, in case such regulations require the naming of optional ingredients present in such ingredient, by a statement showing the optional ingredients which are present in such ingredient.

b) No ingredient shall be designated on the label as a spice, flavoring, or coloring unless it is a spice, flavoring, or coloring, as the case may be, within the meaning of such term as commonly understood by consumers. The term "coloring" shall not include any bleaching substance.

c) An ingredient which is both a spice and a coloring, or both a flavoring and a coloring, shall be designated as spice and coloring, or flavoring and coloring, as the case may be, unless such ingredient is designated by its specific name.

d) A label may be misleading by reason (among other reasons) of:

1) The order in which the names of ingredients appear thereon, or the relative prominence otherwise given such names; or

2) Its failure to reveal the proportion of, or other fact with respect to, an ingredient, when such proportion or other fact is material in the light of the representation that such ingredient was used in fabricating the food.

e) (1) A food shall be exempt from the requirements of clause (2) of section 403 (*i*) of the Act if all words, statements, and other information required by or under authority of the Act to appear on the label of such food, cannot, because of insufficient label space, be so placed on the label as to comply with the requirements of section 403 (*f*) of the Act and regulations promulgated thereunder. But such exemption shall be on the condition that, if the omission from the label of the statement of the quantity of the contents affords sufficient space to state legibly thereon all the information required by such clause (2), such statement of the quantity of the contents shall be omitted as authorized by § 1.9 (*m*) (2), and the information required by such clause (2) shall be so stated as prominently as practicable even though the statement is not of such conspicuousness as to render it likely to be read by the ordinary individual under customary conditions of purchase.

2) In the case of an assortment of different items of food, when variations in the items which make up different packages packed from such assortment normally occur in good packing practice, and when such variations result in variations in the ingredients in different packages, such food shall be exempt from compliance with the requirements of clause (2) of section 403 (*i*) of the Act with respect to any ingredient which is not common to all packages. But such exemption shall be on the condition that the label shall bear, in conjunction with the names of such ingredients as are common to all packages, a statement in terms which are as informative as practicable and which are not misleading, indicating that other ingredients may be present.

j) If it purports to be or is represented for special dietary uses, unless its label bears such information concerning its vitamin, mineral, and other dietary properties as the Administrator determines to be, and by regulations prescribes as, necessary in order fully to inform purchasers as to its value for such uses.

Regulation. [§ 1.11] (*a*) The term "special dietary uses," as applied to food for man, means particular (as distinguished from general) uses of food, as follows:

1) Uses for supplying particular dietary needs which exist by reason of a physical, physiological, pathological or other condition, including but not limited to the conditions of disease, convalescence, pregnancy, lactation, allergic hypersensitivity to food, underweight, and overweight;

2) Uses for supplying particular dietary needs which exist by reason of age, including but not limited to the ages of infancy and childhood;

3) Uses for supplementing or fortifying the ordinary or usual diet with any vitamin, mineral, or other dietary property. Any such particular use of a food is a special dietary use, regardless of whether such food also purports to be or is represented for general use.

b) No provision of any regulation under section 403 (*j*) of the Act shall be construed as exempting any food from any other provision of the Act or regulations thereunder, including sections 403 (*a*) and (*g*) and, when applicable, the provisions of Chapter V.

k) If it bears or contains any artificial flavoring, artificial coloring, or chemical preservative, unless it bears labeling stating that fact: *Provided*, That to the extent that compliance with the requirements of this paragraph is impracticable, exemptions shall be established by regulations promulgated by the Administrator. The provisions of this paragraph and paragraphs (*g*) and (*i*) with respect to artificial coloring shall not apply in the case of butter, cheese, or ice cream.

Regulation. [§ 1.12] (*a*) (1) The term "artificial flavoring" means a flavoring containing any sapid or aromatic constituent, which constituent was manufactured by a process of synthesis or other similar artifice.

2) The term "artificial coloring" means a coloring containing any dye or pigment, which dye or pigment was manufactured by a process of synthesis or other similar artifice, or a coloring which was manufactured by extracting a natural dye or natural pigment from a plant or other material in which such dye or pigment was naturally produced.

3) The term "chemical preservative" means any chemical which, when added to food, tends to prevent or retard deterioration thereof; but does not include common salt, sugars, vinegars, spices or oils extracted from spices, or substances added to food by direct exposure thereof to wood smoke.

b) A food which is subject to the requirements of section 403 (*k*) of the Act shall bear labeling, even though such food is not in package form.

c) A statement of artificial flavoring, artificial coloring, or chemical preservative shall be placed on the food, or on its container or wrapper, or on any two or all of these, as may be necessary to render such statement likely to be read by the ordinary individual under customary conditions of purchase and use of such food.

d) A food shall be exempt from compliance with the requirements of section 403 (*k*) of the Act if it is not in package form and the units thereof are so small that a statement of artificial flavoring, artificial coloring, or chemical preservative, as the case may be, cannot be placed on such units with such conspicuousness as to render it likely to be read by the ordinary individual under customary conditions of purchase and use.

EMERGENCY PERMIT CONTROL

SEC. 404. (*a*) Whenever the Administrator finds after investigation that the distribution in interstate commerce of any class of food may, by reason of contamination with micro-organisms during the manufacture, processing, or packing thereof in any locality, be injurious to health, and that such injurious nature cannot be adequately determined after such articles have entered interstate commerce, he then, and in such case only, shall promulgate regulations providing for the issuance, to manufacturers, processors, or packers of such class of food in such locality, of permits to which shall be attached such conditions governing the manufacture, processing, or packing of such class of food, for such temporary period of time, as may be necessary to protect the public health; and after the effective date of such regulations, and during such temporary period, no person shall introduce or deliver for introduction into interstate commerce any such food manufactured, processed, or packed by any such manufacturer, processor, or packer unless such manufacturer, processor, or packer holds a permit issued by the Administrator as provided by such regulations.

b) The Administrator is authorized to suspend immediately upon notice any permit issued under authority of this section if it is found that any of the conditions of the permit have been violated. The holder of a permit so suspended shall be privileged at any time to apply for the reinstatement of such permit, and the Administrator shall, immediately after prompt hearing and an inspection of the establishment, reinstate such permit if it is found that adequate measures have been taken to comply with and maintain the conditions of the permit, as originally issued or as amended.

c) Any officer or employee duly designated by the Administrator shall have access to any factory or establishment, the operator of which holds a permit from the Administrator, for the purpose of ascertaining whether or not the conditions of the permit are being complied with, and denial of access for such inspection shall be ground for suspension of the permit until such access is freely given by the operator.

REGULATIONS MAKING EXEMPTIONS

SEC. 405. The Administrator shall promulgate regulations exempting from any labeling requirement of this Act (1) small open containers of fresh fruits and fresh vegetables and (2) food which is, in accordance with the practice of the trade, to be processed, labeled, or repacked in substantial quantities at establishments other than those where originally processed or packed, on condition that such food is not adulterated or misbranded under the provisions of this Act upon removal from such processing, labeling, or repacking establishment.

Regulation. [§ 1.13] (*a*) (1) An open container is a container of rigid or semi-rigid construction, which is not closed by lid, wrapper, or otherwise.

2) An open container of a fresh fruit or fresh vegetable, the quantity of contents of which is not more than one dry quart, shall be exempt from the labeling requirements of paragraphs (*e*), (*g*) (2) (with respect to the name of the food specified in the definition and standard), and (*i*) (1) of section 403 of the Act; but such exemption shall be on the condition that if two or more such containers are enclosed in a crate or other shipping package, such crate or package shall bear labeling showing the number of such containers enclosed therein and the quantity of the contents of each.

b) Except as provided by paragraphs (*c*) and (*d*) of this section, a shipment or other delivery of a food which is, in accordance with the practice of the trade, to be processed, labeled, or repacked in substantial quantity at an establishment other than that where originally processed or packed, shall be exempt, during the time of introduction into and movement in interstate commerce and the time of holding in such establishment, from compliance with the labeling requirements of section 403 (*c*), (*e*), (*g*), (*h*), (*i*), (*j*) and (*k*) of the Act if:

1) The person who introduced such shipment or delivery into interstate commerce is the operator of the establishment where such food is to be processed, labeled, or repacked; or

2) In case such person is not such operator, such shipment or delivery is made to such establishment under a written agreement, signed by and containing the post-office addresses of such person and such operator, and containing such specifications for the processing, labeling, or repacking, as the case may be, of such food in such establishment as will insure, if such specifications are followed, that such food will not be adulterated or misbranded within the meaning of the Act upon completion of such processing, labeling, or repacking. Such person and such operator shall each keep a copy of such agreement until all such shipment or delivery has been removed from such establishment, and shall make such copies available for inspection at any reasonable hour to any officer or employee of the Agency who requests them.

c) An exemption of a shipment or other delivery of a food under paragraph (*b*) (1) of this section shall, at the beginning of the act of removing such shipment or delivery, or any part thereof, from such establishment, become void *ab initio* if the food comprising such shipment, delivery, or part is adulterated or misbranded within the meaning of the Act when so removed.

d) An exemption of a shipment or other delivery of a food under paragraph (*b*) (2) of this section shall become void *ab initio* with respect to the person who introduced such shipment or delivery into interstate commerce upon refusal by such person to make available for inspection a copy of the agreement, as required by such paragraph.

e) An exemption of a shipment or other delivery of a food under paragraph

(*b*) (2) of this section shall expire:

1) At the beginning of the act of removing such shipment or delivery, or any part thereof, from such establishment if the food comprising such shipment, delivery, or part is adulterated or misbranded within the meaning of the Act when so removed; or
2) Upon refusal by the operator of the establishment where such food is to be processed, labeled, or repacked, to make available for inspection a copy of the agreement, as required by such paragraph.

TOLERANCES FOR POISONOUS INGREDIENTS IN FOOD AND CERTIFICATION OF COAL-TAR COLORS FOR FOOD

SEC. 406. (*a*) Any poisonous or deleterious substance added to any food, except where such substance is required in the production thereof or cannot be avoided by good manufacturing practice shall be deemed to be unsafe for purposes of the application of clause (2) of section 402 (*a*); but when such substance is so required or cannot be so avoided, the Administrator shall promulgate regulations limiting the quantity therein or thereon to such extent as he finds necessary for the protection of public health, and any quantity exceeding the limits so fixed shall also be deemed to be unsafe for purposes of the application of clause (2) of section 402 (*a*). While such a regulation is in effect limiting the quantity of any such substance in the case of any food, such food shall not, by reason of bearing or containing any added amount of such substance, be considered to be adulterated within the meaning of clause (1) of section 402 (*a*). In determining the quantity of such added substance to be tolerated in or on different articles of food the Administrator shall take into account the extent to which the use of such substance is required or cannot be avoided in the production of each such article, and the other ways in which the consumer may be affected by the same or other poisonous or deleterious substances.

b) The Administrator shall promulgate regulations providing for the listing of coal-tar colors which are harmless and suitable for use in food and for the certification of batches of such colors, with or without harmless diluents.

CHAPTER V—DRUGS AND DEVICES

CHAPTER VI—COSMETICS

CHAPTER VII—GENERAL ADMINISTRATIVE PROVISIONS

CHAPTER VIII—IMPORTS AND EXPORTS

CHAPTER IX—MISCELLANEOUS

SEC. 902. (*b*) Meats and meat food products shall be exempt from the provisions of this Act to the extent of the application or the extension thereto of the Meat Inspection Act, approved March 4, 1907, as amended (U. S. C., 1934 ed., title 21, secs. 71–91; 34 Stat. 1260 *et seq.*).

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INDEX

D

E

K

L

M

N

O

S

T